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Railways, City Transit, Highways, Bridges, Tunnels and Canals, Water-Works, Artesian Wells, Irrigation, Sewerage and Municipal, Electrical, Contracting, Proposals Open, Manufacturing and Technical.

THE GROSS AND NET EARNINGS OF THE UNITED STATES RAILWAYS for the first six months of 1890, according to statistics collected by the *Financial Chronicle*, show that this period has been a period of improvement in the railway transportation business.

The *Chronicle* publishes reports of gross earnings from 240 companies, operating 136,220 miles of railway, and both gross and net earnings from 150 companies operating 94,243 miles of railway. The 240 roads show gross earnings amounting to $443,846,841 as compared with $397,395,032 for the corresponding period of 1889, a gain of $46,451,782. The following table shows the results of operations from the 150 roads, reporting both gross and net earnings:

	January 1 to June 30. (150 roads.)		
	1890.	1889.	Increase.
Miles of road.....	94,243	92,103	2,140
Gross earnings.....	$345,272,509	$309,773,591	$35,498,918
Operating expenses.	240,082,085	216,484,528	23,597,557
Net earnings.....	$105,190,424	$93,289,063	$11,901,361

The detailed list shows that this increase has been quite evenly divided over the whole country.

THE CANADIAN RAILWAY SYSTEM has increased from 7,506 miles in 1881, to 13,324 on June 30, 1889. Of this mileage 9,505 is controlled under three managements, the Government (1,383 miles), the Canadian Pacific (4,973 miles), and the Grand Trunk (3,179 miles), leaving 3,819 miles under other control. The earnings per mile are very low, $3,337; the only lines of large earnings being those between Buffalo and Detroit, which handled a heavy American traffic. Deducting these, the average earnings of the Canadian system are some $2,650 per mile. The train miles per mile of road have decreased from 3,760 in 1881, to 3,074 in 1889, because of the large mileage constructed in thinly-populated districts. The inhabitants per mile of road are 383, against about 400 in the United States.

THE HENDERSON BILL, requiring the application of automatic brakes and couplers to all cars engaged in interstate commerce, has been favorably reported by the House Committee on Railways and Canals, with a strong recommendation that it be passed. The dates fixed after which it shall be unlawful to operate cars in interstate commerce lacking these appliances are Jan. 1, 1895, for couplers, and Jan. 1, 1893 (amended from 1892), for power brakes, after which dates any corporation is authorized to refuse cars not so equipped; but the provisions for fines are stricken out, and a new clause is added giving the Interstate Commerce Commission power to fix the price of any brake or coupler complying with the act which any company may desire to use, with the proviso that if they are not purchasable in the market at that price the company shall be relieved of responsibility.

A NEW VENTILATED FREIGHT CAR, designed by Mr. R. M. DANCOAST, was tested in the Pennsylvania yards this week with entire success, it is reported. The car was right behind the engine, which threw out much smoke, but this did not reach the interior of the car, which was ventilated by a thin sheet of air driven vertically downward along its sides, there being exhausts overhead in the center of the car. The draft was strong throughout the car, which is primarily designed for perishable freight transportation.

THE WORST ACCIDENT OF THE WEEK occurred on Aug. 22 on the Mt. Penn Gravity Ry. at Reading, Pa., and is described elsewhere by a correspondent. It was a runaway of a car on a steep grade on account of the failure of the brakes to work, and caused 6 deaths and 13 injuries. Two other runaways on steep grades occurred on the same day in Colorado. In one case the air brakes on a stone train failed to hold it, probably because the air in the reservoirs became exhausted. In the other, some air-braked freight cars were left standing without the hand brakes applied. The brakes leaked off and the cars ran down the grade, striking another freight train. The casualties from these two accidents were 7 killed and as many injured.

CATTLE ON THE TRACK have caused two bad accidents this week. In one, near Radford, Va., on the Norfolk & Western, the train rolled down a bank upon some shanties occupied by Italian laborers. Four men were killed and a number injured. On the Texas & Pacific a derailment due to cattle on the track killed a brakeman and seriously injured the fireman and engineer.——Land slides have occurred on the Delaware & Hudson near Crown Point, N. Y., and on the Colorado Midland.

COLLISIONS continue frequent and fatal. The two worst were due to misplaced switches, one occurring at Millen, Neb., on the Burlington & Missouri River R. R., killing 3 and wounding 6; and the other on the Baltimore & Ohio, at Germantown Station, 66 miles west of Baltimore, killing 3 trainmen. Other collisions, a dozen or so in number, have killed or fatally injured 7 or 8 persons.

BRIDGE ACCIDENTS have been numerous. On the Terre Haute & Peoria R. R., Aug. 22, five cars and a caboose of a freight train went through a bridge near Atlanta, Ill., fatally injuring a brakeman. The cars are said to have been derailed on the bridge.——On the Gulf, Colorado & Santa Fé, near Milan, Tex., six cars of a freight train fell off a trestle, injuring one man. Probably both of these accidents would have been prevented by proper bridge floors and guard rails.——A work train on the Ft. Worth & Denver City branch of the Union Pacific broke through a small bridge near Trinchera station, whose foundations had been undermined by a freshet. One man was killed and a score were badly hurt.——Highway bridge failures are reported at Kenton, O., and at Weston, Ont. In both cases the bridge fell while a heavy load was crossing.——An iron bridge 500 ft. long over the Monocacy River, near Frederick, Md., was wrecked by a tornado last week.

THE THREE LINE-OF-BATTLE SHIPS, appropriation for the construction of which was made in the bill of June 30, 1890, are the most powerful vessels yet designed for the United States Navy. According to the general designs the length on load water line will be 332 ft.; extreme breadth, 69 ft.; draught, 24 ft.; displacement, 9,000 tons, and maintained sea speed, 15 knots. The armament will consist of a main battery of four 13-ins. breech-loading rifles protected by steel turrets 17 ins. thick, working inside raised steel barbettes 17 ins. thick; an auxiliary battery of four 8 ins. and four 6 ins. breech-loading rifles protected by steel turrets and barbettes 6 ins. thick each, and a secondary battery of 20 six-pounder and 6 one-pounder rapid fire guns and two Gatlings, protected by 4 ins. of steel armor and shields. The vessel at water line is protected by an armor belt 18 ins. thick, backed by wood, and above this by 5½ ins. of armor backed by the coal bunkers. The engines must show 9,000 I. HP. under forced draft, and 7,000 under natural draft. The cylinders are 34½ ins., 48 ins., and 75 ins. diameter with a 42-in. stroke. The steam pressure will be 160 lbs., and the maximum number of revolutions 128. The vessels are to cost not exceeding $4,000,000 each.

THE TRIAL TRIP OF THE CRUISER *San Francisco*, which took place Aug. 27, resulted successfully, the vessel making an average speed of 19.70 knots per hour, or 0.70 knots in excess of the required speed. The maximum speed attained was 20.06 knots per hour. The cruiser was built by the Union Iron Works, of San Francisco, Cal., and is the second vessel of the new navy to be built on the Pacific coast. The machinery was designed by the Bureau of Steam Engineering, and differs in several particulars from that of the other cruisers. The dimensions of the vessel are: Length, 310 ft.; breadth, 49.1 ft.; draught, 18.9 ft.; displacement, 4,083 tons, and indicated horse power, 10,500. The contract price for the vessel, exclusive of armament, was $1,426,000, and her builders will receive in addition a premium of $100,000 for her excess of speed over contract requirements. Among the novel features of the vessel's machinery are the small grate surface of 500 sq. ft., and the forced draught, which is on the closed ashpit system.

THE TRANSATLANTIC RECORD of several of the new ocean greyhounds is being rapidly lowered. The return race across the ocean between the *City of New York* and *Teutonic* resulted in a victory for the former, which made the passage in 6 days and 40 minutes. The *Teutonic* left New York 20 minutes after her rival and made the trip in 6 days 2 hours 45 minutes. During the first 760 miles af the passage the two vessels remained in sight of each other. The log of the *City of New York* shows the average speed to have been a trifle over 19¼ knots per hour. The greatest days run was 461 miles or within 14 miles of the fastest run made by the *City of Paris* on her famous trip. The *Majestic*, the latest addition to the White Star fleet, is also proving a remarkably swift vessel. She reached New York Aug. 27, having made the passage in 5 days, 22 hours, 21 minutes, which is within 3 hours 3 minutes of the *City of Paris'* record. It is claimed the *Majestic* would have broken the record on this trip had she not been delayed by fog. The previous westward trip of the *Majestic* was made in 5 days 23 hours 58 minutes.

THE MERCHANTS' BRIDGE TERMINAL CO., of St. Louis, is to increase its capital stock $1,500,000, and will issue bonds for a like sum. The money raised will be used to increase the terminal facilities by the erection of a union passenger depot, freight depots and warehouses, with a large amount of sidings.

LABOR TROUBLES seem unusually numerous. The New York Central strike seems to be about settled as the places of the striking employés have been fully supplied. A gigantic boycott and counter boycott in the brick trade threatens to paralyze the building industry in New York. The Knights of Labor declared a boycott on the product of the Verplancks' Point brick yards for employing non-union men. The Association of Brick Manufacturers of New York and New Jersey took up the cudgel in defence of the boycotted yards, and have agreed that until the boycott is raised no brick except the boycotted brick shall be delivered in New York or Brooklyn. In Chicago the strike of the switchmen employed by the Stock Yards Switching Association has caused the dissolution of the association, and each road will hereafter do its own switching in the stock yards. The Chicago & Alton switchmen have also struck because of a change in the yard foremen, and the Illinois Central trainmen have demanded an increase of wages of 5 to 30 percent.

Method of Calculating the Strains in a Whipple Truss for a Concentrated Loading.

BY WARD BALDWIN, PRIN. ASST. ENG. C., N. O. & T. P. R. W.

The analytical conditions for determining the position of a concentrated loading that will produce the maximum moment or shear at a given point of a simple truss or girder have been long known and widely used.

The graphical method of using the "load line" to determine the position of the loading that will produce the maximum moment in a simple truss or girder has also been long known, and was, I believe, first worked out by Mr. C. L. STROBEL more than ten years ago.

The graphical method of using the "load line" to determine the position of the loading that will produce the maximum shear in a simple truss was deduced by Prof. H. T. EDDY more than three years ago.

These graphical methods are given in the article published Sept. 28, 1889, in ENGINEERING NEWS, and the graphical method is there extended to the construction and use of the "Moment Diagram."

These methods enable one to determine with very little labor the maximum strains in simple trusses and girders for any concentrated loading. But the work required to determine the maximum strains in more complicated systems of trussing has led engineers to use an "equivalent uniform loading" instead of the specified concentrated loading for such trusses. This custom of using an "equivalent load" for all spans except simple trusses and girders has been adopted quite generally because, so far as is known to the writer, there has as yet been no method published whereby the positions of the actual concentrated loading that produce the maximum strains can be quickly and simply determined.

It is proposed to give here a simple method, partly graphical and partly analytical, for finding the positions of the concentrated loading that will produce the maximum chord strains in a Whipple, or double intersection truss.

The position of the loading producing the maximum strain in the first and second panels of the lower chord is determined by the method given on page 295 of the last volume of ENGINEERING NEWS (Sept. 28, 1889) for a single truss.

The position of the loading producing the maximum strain in any other panel of the lower chord is found as follows:

Let h be the depth of the truss, c. to c. of chords.
Let N be the number of panels in the span.
Let n be the number of the panel in which the max. strain is desired.
Let S_n be the strain in this panel.
Let p be the length of a panel.
Let P be the total load on a panel length.
Let R be the total load on the span.
Let R' be the total load between the left pier and the n^{th} panel.
Let L be the load at a panel point.
Let α be the angle of the main ties with the vertical.
Let a be the distance of the center of application of R from the right hand pier.
Let b be the distance of the center of application of R' from the right pier.
Let $d = (n-1)\,p$ be the distance from the left pier to the n^{th} panel
Let T_1, T_2, etc., be the strains in the diagonals, 1, 2, etc.
Let Q be the total reaction at the left hand pier.
Let Q_I be the reaction at the left hand pier for the system of panel points a, 1, 2, 4, 6, etc., called system I.
Let Q_{II} be the reaction at the left hand pier for the system of panel points a, 1, 3, 5, 7, etc., called system II.

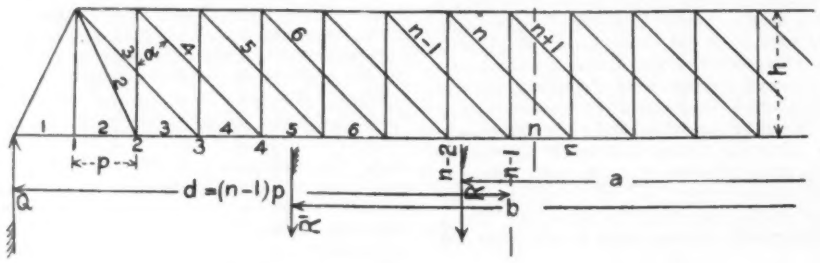


FIG 1.

The load at the panel points 1 and $N-1$ are supposed to divide equally between systems I and II. Suppose any system of loads, W, to be on the given span, the loading being taken in such a position that no load, W, is over a panel point; then the total reaction at the left pier is $Q = \frac{R\,a}{l}$

Now take a vertical section through the truss at the n^{th} panel of the lower chord, and take moments about the point of the upper chord at the $(n-1)^{th}$ panel point to determine the value of S_n; then

$$S_n = \frac{1}{h}\left(\frac{R\,a}{l}\,d - R'\,(b - l + d) - p\,\cos.\,\alpha\,T_n\right) \qquad (a)$$

Suppose now that the loading moves a small distance $\triangle x$ to the left, the amount of motion being so small that no load W passes onto or off of any panel; then

$$S_n + \triangle S_n = \frac{1}{h}\left\{\frac{R\,(a + \triangle x)}{l}\,d - R'\,(b + \triangle x - l + d) - p\,\cos.\,\alpha\,(T_n + \triangle T_n)\right\}$$

The strain in the n^{th} panel is thus changed by

$$\triangle S_n = \frac{1}{h}\left\{\left(\frac{R}{l}\,d - R'\right)\triangle x - p\,\cos.\,\alpha\,\triangle T_n.\right\}$$

Now let t_{n-2} represent the vertical component of T_n, then $p\,\cos.\,\alpha\,\triangle T_n = p\,\triangle t_{n-2}$, and

$$\triangle S_n = \frac{1}{h}\left\{\left(\frac{R}{l}\,d - R'\right)\triangle x - p\,\triangle t_{n-2}\right\} \qquad (b)$$

The strain will therefore be increased by moving the loading to the left if

$$\left\{\left(\frac{R}{l}\,d - R'\right)\triangle x - p\,\triangle t_{n-2}\right\} \qquad (c)$$

is positive, and will be increased by moving the loading to the right if this expression is negative.

If now the loading is supposed to be in a position a little to the right of that producing the maximum strain in the n^{th} panel of the lower chord, and is supposed to move a distance $\triangle x$ toward the left a little beyond the position of maximum strain in the n^{th} panel of the lower chord, and if it is further supposed that the motion is so small that no load W passes on or off of the span, then $\left(\frac{R}{l}\,d\right)$ has the same value for both positions of the loading; and since the expression (c) is positive for the first position, and negative for the second position of the loading, it follows that $(R' \triangle x + p \triangle t_{n-2})$ must be less than $\left(\frac{R}{l}\,d\right)$ for the first position, and must be greater than $\left(\frac{R}{l}\,d\right)$ for the second position of the loading. Now R' can only be increased by some load W passing from the right to the left of the $(n-1)^{th}$ panel point when the loading moves from its first to its second position, and since $\triangle x$ is infinitely small, $\triangle t_{n-2}$ can only be changed in value by some load W passing some panel point as the loading passes from its first to its second position. Now, as the loading moves toward the left across the span, it reaches such a position that when some load W is on the right of some panel point, expression (c) is positive; and when the same load W is on the left of this panel point, expression (c) is negative.

Hence, when some one of the loads W is at a certain panel point, the value of S_n is a maximum. It can only be found by trial which panel point and which load W must coincide in order for the maximum strain to exist in a given panel. An approximate position may be found as follows:

The maximum moment at a given panel point of a simple truss was shown on page 295, Vol. XXII., to exist when some load, W, was at that point provided $\left(\frac{R\,d}{l} - R'\right) \triangle x$ was $\pm$ according as this load W was on the right or left of the panel point. Now expression (c) for the Whipple truss is seen to be identical with this expression for a simple truss except that the quantity $(-p \triangle t_{n-2})$ is added to it.

Therefore, to find the approximate position of the loading for the maximum value of S_n, draw a "load line" for the given loading as explained on page 295, mark off on a slip of paper the panels of the given span, and then place this slip at such a position on the "Load Diagram" that when some load, W, is over the $(n-1)^{th}$ panel point, a thread stretched between the points of the "load line" that are vertically over the ends of the span will cut that part of the "load line" representing this load W. The loading will then be in the position producing the maximum moment at the $(n-1)^{th}$ panel point. By applying condition (c) to this position of the loading, the position of the loading giving the maximum of S_n can be readily determined.

This expression can evidently be applied to determine the maximum strains in all the panels of the lower chord beyond the second until a panel is reached in which there are counters. The maximum strains in the upper chord panels are also determined at the same time since the maximum strains on the panels of the upper and lower chord, situated between adjacent diagonals, are equal.

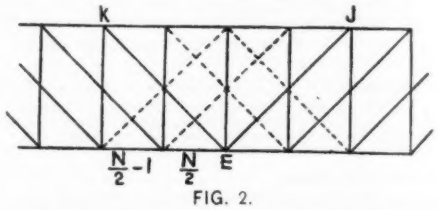


FIG. 2.

When N is even, the bracing at the middle of the span is arranged as in Fig. 2, the dotted lines representing the counters.

Now for the system of loading usually specified and consisting of two engines facing the left and followed by a uniform load, the counters will not be strained by the combined effect of the dead and live load when the loading is in the position giving the maximum strain in the $\left(\frac{N}{2} - 1\right)^{th}$ or $\left(\frac{N}{2}\right)^{th}$ panel of the lower chord. The counters can therefore be neglected in finding the maximum strains in these panels, and evidently expression (c) will apply to these panels as well as to the preceding panels. The strain on the panels of the upper chord between k and j is uniform, and the position of the loading giving the maximum strain in $k\,j$ is evidently that position corresponding to the maximum at m, the middle panel point of the span. This position is determined just as for a simple truss, as explained on page 295.

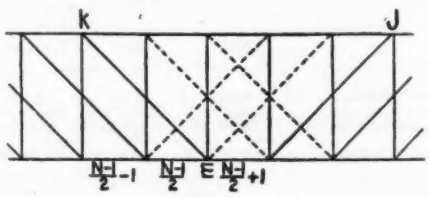


FIG. 3.

When N is odd the bracing at the middle of the span is arranged as in Fig. 3, the dotted lines representing the counters.

Here, as in the case when N is even, the counters will not usually be strained by the combined effect of dead and live load, except in the middle panel. Therefore expression (c) will apply to the $\left(\frac{N-1}{2}\right)^{th}$ and $\left(\frac{N-1}{2} - 1\right)^{th}$ panel as well as to the preceding panels. The maximum strain in the upper chord k j and in the $\left(\frac{N-1}{2} + 1\right)^{th}$ panel of the lower chord is the same, and is produced by that position of the loading, producing the maximum moment at the panel point m. This position can evidently be deter-

mined just as for a simple truss as explained on page 295.

It remains now to find the value of $(p \triangle t_{n-2})$. This value depends upon whether N and n are odd or even. Suppose N is even and n is odd. The diagonal n, Fig. 1, is in system II and

$$\triangle t_{n-2} = \triangle Q_{II} - \left(\frac{\triangle L_1}{2} + \triangle L_3 + \triangle L_5 + \ldots + \triangle L_{n-2}\right) = \frac{\triangle L_1}{2}\left(\frac{N-1}{N}\right) + \triangle L_3\left(\frac{N-3}{N}\right) + \triangle L_5 \left(\frac{N-5}{N}\right) + \ldots + \triangle L_{N-3}\left(\frac{3}{N}\right) + \triangle L_{N-1}\left(\frac{1}{2N}\right) - \left\{\frac{\triangle L_1}{2} + \triangle L_3 + \triangle L_5 + \ldots + \triangle L_{n-2}\right\} -$$

$$\frac{\triangle x}{p}\left\{(P_2 - P_1)\frac{N-1}{2N} + (P_4 - P_3)\frac{N-3}{N} + (P_6 - P_5)\frac{N-5}{N} + \ldots + (P_{N-2} - P_{N-3})\frac{3}{N} + (P_N - P_{N-1})\frac{1}{2N}\right\} -$$

$$\frac{\triangle x}{p}\left\{(P_2 - P_1)\frac{1}{2} + (P_4 - P_3) + (P_6 - P_5) + \ldots\ldots + (P_{n-1} - P_{n-3})\right\} -$$

$$\frac{\triangle x}{p}\left\{(P_2 - P_1)\frac{N-1}{2N} + \sum_3^{N-3}(P_{y+1} - P_y)\frac{N-y}{N} + (P_N - P_{N-1})\frac{1}{2N}\right\} -$$

$$\frac{\triangle x}{p}\left\{\frac{P_2}{2} + \sum_4^{n-1} P_z - \frac{P_1}{2} - \sum_3^{n-2} P_y\right\}$$

where y has only odd values and z has only even values.

Substitute this value of $\triangle t_{n-2}$ in equation (b), and substitute Np for l, then

$$\triangle S_n = \frac{\triangle x}{h}\left\{\frac{R(n-1)}{N} - R' - \left[(P_2 - P_1)\frac{N-1}{2N} + \sum_3^{N-3}(P_{y+1} - P_y)\frac{N-y}{N} + (P_N - P_{N-1})\frac{1}{2N}\right] + \left(\frac{P_2}{2} + \sum_4^{n-1} P_z - \frac{P_1}{2}\sum_3^{n-2} P_y\right)\right\}$$

Now as before stated the position of the loading for the maximum value of S_n is such that some load W is over a panel point; and the condition for determining this position is, that when this wheel W moves from the right to the left of this panel point the sign of the expression for $\frac{h \triangle S_n}{\triangle x}$ changes from positive to negative.

When N is even and n is odd

$$\frac{h \triangle S_n}{\triangle x} = \frac{R(n-1)}{N} - R' - \left[(P_2 - P_1)\frac{N-1}{2N} + \sum_3^{N-3}(P_{y+1} - P_y)\frac{N-y}{N} + \left(P_N - P_{N-1}\right)\frac{1}{2N}\right] + \frac{P_2}{2} + \sum_4^{n-1} P_z - \frac{P_1}{2} - \sum_3^{n-2} P_y \qquad (1)$$

When N and n are both even

$$\frac{h \triangle S_n}{\triangle x} = \frac{R(n-1)}{N} - R' - \left[(P_2 - P_1)\frac{N-1}{2N} + \sum_2^{N-2}(P_{z+1} - P_z)\frac{N-Z}{N} + \left(P_N - P_{N-1}\right)\frac{1}{2N}\right] + \sum_3^{n-1} P_y - \frac{P_1}{2} - \frac{P_2}{2} - \sum_4^{n-2} P_z. \qquad (2)$$

When N and n are both odd,

$$\frac{h \triangle Sn}{\triangle x} = \frac{R(n-1)}{N} - R' - \left[(P_2 - P_1)\frac{N-1}{2N} + \sum_3^{N-2}(P_{y+1} - P_y)\frac{N-y}{N} + \left(P_N - P_{N-1}\right)\frac{1}{2N}\right] + \frac{P_2}{2} + \sum_4^{n-1} P_z - \frac{P_1}{2} - \sum_3^{n-2} P_y \qquad (3)$$

When N is odd and n is even

$$h\frac{\triangle S_n}{\triangle x} = \frac{R(n-1)}{N} - R' - \left[(P_2 - P_1)\frac{N-1}{2N} + \sum_2^{N-3}(P_{z+1} - P_z)\frac{N-Z}{N} + (P_N - P_{N-1})\frac{1}{2N}\right] + \sum_3^{n-1} P_y - \frac{P_1}{2} - \frac{P_2}{2} - \sum_4^{n-2} P_z \qquad (4)$$

In all these expressions y had only odd values and Z has only even values.

It will be observed that all the quantities in these expressions can be taken directly from the load diagram. Thus R is the total load on the span; R' is the total load between the left pier and the $(n-1)^{th}$ panel point; P is the sum of the loads between the left pier and the 1st panel point; P_2 is the sum of the loads between the 1st and 2d panel points, etc. These quantities can therefore be read directly from the load diagram by putting the slip of paper on which the panels are laid off on the diagram, so that the loading will be in the required position with reference to the panel points on the slip of paper. The practical simplicity of the application of these equations of condition may be illustrated by a numerical example.

Take a span 242 ft. 8 ins. long, divided into 14 panels each 17 ft. 4 ins. long and 20 ft. high, center to center of chords, shown in Fig. 4.

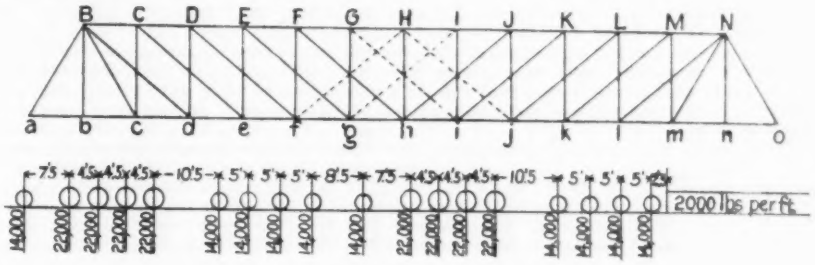


FIG. 4.

Suppose the loading to be that given in the load diagram. Draw the "load line" for this loading in the manner described on page 295, and lay off on a slip of paper the panels of the span.

By moving this slip of paper on the "load diagram" and stretching thread, as described on page 295, the maximum moments at the panel points are found to exist:

At b when wheel 3 is at b.
At c when wheel 5 is at c.
At d when wheel 7 is at d.
At e when wheel 10 is at e.
At f when wheel 12 is at f.
At g when wheel 13 is at g.
At h when wheel 14 is at h.

Now, as explained above, the maximum strain in $a\,c$ will be equal to the moment at b, when wheel 3 is at b, divided by the height of the truss; and the maximum strain in FJ will be the moment at h, when wheel 14 is at h, divided by the height of the truss.

For the span here illustrated N is even.

For panel $c\,d$, $n = 3$ is odd, and expression (1) applies.

When wheel 5 is just to the left of c, the value of (1) is

$$\frac{283{,}000 \times 2}{14} - 51{,}000 - [(44{,}000 - 7{,}000)\tfrac{13}{14} + (21{,}000 - 14{,}000)\tfrac{11}{14} + (18{,}000 - 33{,}000)\tfrac{3}{14} + (17{,}320 - 24{,}670)\tfrac{1}{14}] + \frac{44{,}000}{2} - \frac{7{,}000}{2} = 40{,}430 - 9{,}130.$$

Since this value is positive, the loading must be moved to the left. Take wheel 6 at c. When wheel 6 is just to the right of c, the value of (1) is

$$\frac{283{,}500 \times 2}{14} - 51{,}000 - [(22{,}000 - 29{,}000)\tfrac{13}{14} + (18{,}000 - 28{,}000)\tfrac{11}{14} + (21{,}000 - 33{,}000)\tfrac{3}{14} + (17{,}330 - 21{,}170)\tfrac{1}{14}] + \frac{22{,}000}{2} - \frac{27{,}000}{2} = 41{,}930 - 33{,}660.$$

Since this value is positive, the loading must be moved to the left.

When wheel 6 is just to the left of c, the value of (1) is

$$41{,}930 - 58{,}000 - [(29{,}000 - 29{,}000)\tfrac{13}{14} + (18{,}000 - 21{,}000)\tfrac{11}{14} + (21{,}000 - 33{,}000)\tfrac{3}{14} + (17{,}330 - 21{,}170)\tfrac{1}{14}] + \frac{29{,}000}{2} - \frac{29{,}000}{2} = 41{,}930 - 46{,}010.$$

Since the value of (1) is positive when wheel 6 is on the right of c, and negative when wheel 6 is on the left of c, it follows that the maximum strain in $c\,d$ exists when wheel 6 is at c.

For panel $B\,C$ or $d\,e$, $n = 4$ is even, and expression (2) applies. When wheel 7 is just to the right of d the value of (2) is

$$\frac{281{,}170 \times 3}{14} - 58{,}000 - [(33{,}000 - 7{,}000)\tfrac{13}{14} + (18{,}000 - 33{,}000)\tfrac{11}{14} + (29{,}000 - 21{,}000)\tfrac{10}{14} + (22{,}830 - 29{,}000)\tfrac{1}{14}] + 18{,}000 - \frac{33{,}000}{2} - \frac{7{,}000}{2} = 60{,}250 - 65{,}810.$$

Since this value is negative the load must move to the right.

When wheel 12 is just to the right of f, the value of (2) is

$$\frac{277{,}000 \times 3}{14} - 58{,}000 - [(20{,}000)\tfrac{13}{14} + (29{,}000 - 29{,}000)\tfrac{11}{14} + (18{,}000 - 21{,}000)\tfrac{10}{14} + (28{,}000 - 33{,}000)\tfrac{3}{14} + (17{,}330 - 15{,}000)\tfrac{1}{14}] + 29{,}000 - \frac{29{,}000}{2} = 50{,}360 - 52{,}970.$$

Since this value is positive the load must move to the left.

When wheel 12 is just to the left of f, the value of (2) is

$$59{,}360 - 58{,}000 - [29{,}000\tfrac{13}{14} + (29{,}000 - 29{,}000)\tfrac{11}{14} + (29{,}000 - 21{,}000)\tfrac{10}{14} + (28{,}000 - 22{,}000)\tfrac{3}{14} + (17{,}330 - 15{,}000)\tfrac{1}{14}] + 29{,}000 - \frac{29{,}000}{2} = 59{,}360 - 67{,}110.$$

Since the value of (2) is positive when wheel 12 is on the right of f, and negative when wheel 12 is on the left of f, it follows that the maximum strain d exists when wheel 12 is at f.

The position of the loading producing the maximum chord strains having been found for each panel, the actual value of the strain can be readily found by using equation (a).

First Rides on English Cars.

In a recent number of *Harper's Weekly*, JULIAN RALPH has a very readable paper with the above title, which gives so good an idea of English railway carriages that we make the following extracts from it:

The truest comparison and fairest statement of the facts concerning English and American railroads is that if they had our cars and we had their roads, both countries would enjoy railroading in perfection.

In order to present the completest picture to the American reader, let him or her imagine a summer horse-car with the sides boarded up—one of those horse-cars we New Yorkers ride upon Third Avenue in, with cross seats facing one another in pairs. Let him imagine the back of every alternate seat carried up to the ceiling. That would divide the car into three or four boxes. Then put a window at each end of each seat, and a door at each end of each passage. The windows must be tight and immovable, but there must be a sliding window in every door, to hoist up and down by means of a broad, leather strap, worn black and soft by handling. Now mark "Third Class" on the boxes that are over the wheels at either end of the car, and paint "First Class" on the boxes between the wheels in the middle of the car. Cushion the first-class seats, and pad their backs as high as one's head; then carpet the third-class seats, and nail carpet on their backs, and you have turned an open horse-car into an English railway carriage. There is a narrow board on each side of the horse-car for the conductor to walk upon, and that is there also on the English car; but the English railroad car is boarded up at either end, whereas the American horse-car is glazed.

Now let the American think of all the comforts and conveniences there are in our railroad coaches—the toilet stand, the closet, the heating apparatus, the drinking-water cylinder. Not one of these is in an English railroad car—not one. All those things are at the station, not in the cars. In the English cars there is an ineffectual and timid light, half concealed above a thick convex glass in the roof of each compartment, and there is a rack over each seat. Posted in each compartment is a statement of the number of persons it is designed to accommodate. "This compartment is for ten persons," was always posted in the third-class and second-class compartments; in the first-class ones the seats are divided by padded arms to accommodate three persons each, or six to the compartment.

You buy your ticket at what the English are pleased to call a "booking-office," because in another century it was the custom to enter your name in a book in order to secure your passage in a stage-coach. And, by-the-way, that stage-coach influence is so dominant that more than half

the passenger cars to-day are shaped so as to suggest the body of a stage-coach, with a rounded roof and queer little ornamental lines or ridges along the sides, curving up at either end as the body of the coach used to. And what are the little compartments of the cars but so many stage-coach interiors—seats, racks, door-windows, straps, and all?

You buy your ticket, and get a porter, or guard, in blue livery, who leads you and carries your bag to whatever sort of compartment your ticket calls for. You "tip" him, of course, with two pence if you are English, and a shilling if you are American. Presently a man with the word "Inspector" on his cap goes along calling out: "Tickets, tickets, please." He takes your ticket, and, using a clumsy, heavy punch, gouges a great hole out of the edge of the card-board—a V-shaped hole, or one that is shaped like half a cracker. Then there is a moment of extraordinary bustle, during which guards run along slamming the doors of all the compartments. After that the train moves, and there you are, shut in a wretched little box, it may be for hours. Your knees all but touch the knees of the man in front of you. If it happens that the men who sit by the windows wish them open, you sit in the most violent, perhaps the most chilling wind. If they want the windows closed, you may suffocate. You will certainly breathe enough bad air to develop a headache. One of them may be drunk, one may smoke a pipe—first class or third class this may all happen—or one may want to fight, but there you are, taking whatever comes.

Where the long stops are made at the important stations, there are lunch counters very like ours, and news stands and drinking faucets, and all the rest. There is also time to stretch one's legs and look over the baggage to see that one's trunk is not put off by mistake, for the English traveler on most roads must, in a measure, be his own baggage agent, and can have no peace of mind until he is accustomed to the English system, and finds that it works well. It does work well, though there seems no logical reason why it should.

Though I had read about English railroads all my life, they were new to me when I saw them.

The small size, the absolute plainness and the simplicity, almost rudeness, of both the cars and the engines surprised me. They looked to me like slightly magnified toy trains, such as the Germans send to our toy dealers for Christmas time. Nearly everything that is intensely useful in England is intensely plain, if not ugly, as I discovered afterward. Just as our locomotives are among the most attractive of our works, suggesting the very poetry of speed and strength combined with lightness, so theirs are among the ugliest of man's creations, indicative only of weight and strength and solidity. So it is with most of their creations. Their omnibuses are the quintessence of awkwardness and clumsiness; their cars are mere boxes; their wagons are cumbrous to the utmost degree; their steamboats are hideous: their other river craft are rude beyond belief. I should think, without having measured them, that the English cars are more than 3 ft., perhaps 4 ft., lower than ours, and at least 2 ft. narrower. Fancy, then, how much smaller they must seem when you understand that you never enter them by steps, but go into them from platforms built nearly up to the level of the car flooring. You can almost see over a train as it draws up at a station. A tall man stands up in the cars and has room to spare, but he must stoop to enter the doors.

[The relative dimensions of a first-class carriage of the Caledonian Ry., of England, and of the Pennsylvania R. R. standard passenger car are as follows:

	Penna. R. R. Std. pass. car.	Caledonian Ry. first-class carriage.
Height above rail.....	14 ft.	9 ft. 7¼ ins.
Width over all.....	9 ft. 5 ins.	8 ft. 7¼ ins.
Length "	52 ft.	30 ft.
Weight (about).....	50,000 lbs.	22,000 lbs.
Seating capacity...	52	24

The cubic feet of space per passenger when each car is fully loaded is about the same. It will be seen from the above that Mr. RALPH'S impressions of the small size of English railway carriages, as compared with American cars, are nearly correct.—ED.]

The freight cars seem positively absurd. They call them "goods waggons," and they are as queer and awkward as those words look to us. The great majority of them are what we call flat cars, or gondolas, but they are not half as long as our gondolas; in fact, they are little longer than our coal cars. They ride on four high skeleton or spoked wheels—very like wagons indeed. Very often, after they are loaded, the freight in them is covered over with tarpaulin cloth, as our Long Island farmers protect their vegetables when they cart them to market. There are box cars in England, but they seemed to me comparatively few in number, and they were only half as big as ours.

The English locomotives look as if they were all cast in one piece, and then had the wheels added. I am not mechanic enough to say how they are made, but they seem to show one unbroken expanse of black iron from the boiler-head to the fire-box. And their little short smoke-stacks, the curving shields over their wheels, and the sheet of metal that makes apology for a cab seems all one piece of metal run out of one mould. You see little of their working gear except their wheels and driving-rods, and the cab for the engineer and fireman is usually a plain upright wall of iron a little higher than the heads of those operatives, and provided with two round goggle windows, one on either side, for them to look ahead through. A few of the newer engines are made so that this wall of metal curves over the heads of the men, but even these are open at the sides. This seems cruel, but I suspect that the true cruelty is in our extremes of climate, which compel our engineers to be almost completely housed. The low, short, small, black locomotives are usually as devoid of ornament as a cat that has escaped from a fire with nothing but its life.

I never understood, with all my reading, that instead of the trains being divided into first, second and third class cars, it is the cars that are divided into compartments for the different classes. Of course there are first-class cars and third-class ones, but those are the exceptions. I saw very few. The rule is to apportion one car among the various classes, and to mark "third-class" those forward and rear boxes that are over the wheels. They are so set apart because those who ride in them feel the grinding and pounding of the wheels, which is not the case with those who ride "first-class" in the middle compartments. There is always a luggage compartment on every train, of course—a bare room in which the baggage is heaped. The guard's box is also a feature of every train. It is a very small compartment with a projecting window at each end, and a seat in each window. From this the guards command a view of the sides of the train.

It is said that only lords, Americans, and fools ride first class, and it is very nearly true, the fact being that very nice and very well-to-do English men and women use the cheapest compartments. The reason is that there is a very wide difference in the cost, and a very slight difference in the accommodations. Third-class fares are about the same as the regular passenger rate in New York State—two cents a mile. To ride first class in England costs a little more than three cents and a half a mile. I say little about second-class fares or compartments because there never was any logical excuse for a second class, and already one great road has abandoned that grade of service.

An English railroad journey is not apt to be so pleasant as a ride of similar length at home. This is because of the law which prevents railroads crossing roads or other tracks at a level. When you are walking or carriage riding in England you seldom see a railroad until you cross over it upon a bridge, and the consequence of this altogether admirable custom is that when you are in English cars you are usually below the level of the surrounding country. When entering London you ride through mile after mile of the city without being made aware that you are within the metropolis, except by the names of the stations on the way. Where the population is dense the road is apt to be laid between walls of masonry, and even in the open country you are continually riding between sloping banks of grass that hide from you any other view. When there comes a bit of riding on the level of the surrounding country the tracks are fenced in by hedges or walls of old "sleepers." The views one gets—and some of them are truly fine, as those among the peaks of Derby on the Midland route—are occasioned by passage through rolling, hilly, or mountainous country, where the maintenance of the road level often brings the tracks above the valleys or between the hills.

The roadbeds are vastly better than ours. All that I saw were rock ballasted, and laid with very heavy steel rails. Then, again, the rails, which are shaped differently from ours, are fastened to every tie by a chair, so that "spreading" appears to be impossible. The finish and cost and solidity of every adjunct of an English roadbed surprise Americans. The miles upon miles of masonry at either side of the track; the stations of stone or brick; the stone platforms; the stone bridges; the carefully kept neat grass lines at the sides of the tracks; the truly enormous stations in the great cities, often accompanied by grand hotels maintained by the companies—all these features surprise and please every intelligent traveler who has thought a journey to Philadelphia offered the most perfect riding in the world, and who imagined the Fourth avenue sunken track and Grand Central Station in New York the most costly railroad constructions known to man.

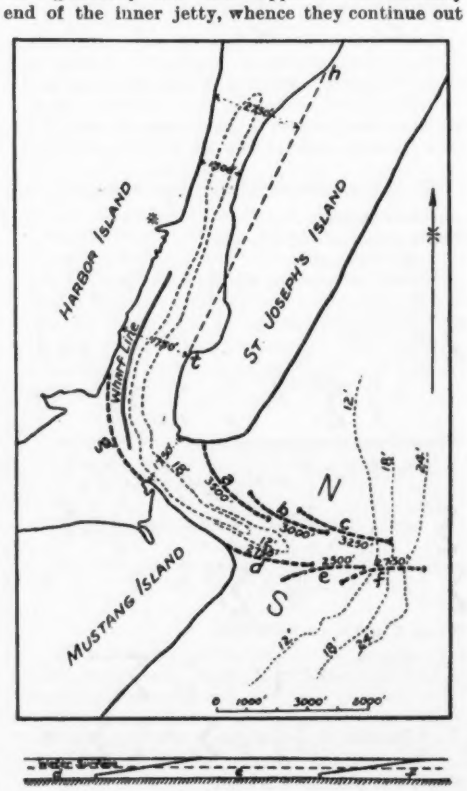
There is nothing without a cause, and the cause of this perfection in English railroad building is not difficult to find—not a tenth so difficult as it is to give a reason for their holding to their absurd and inadequate rolling stock. England is a small country densely populated. Her cities were built up before the roads were constructed, and to construct them was to make certain of enormous traffic. From end to end England is only 385 miles long; from side to side, at the broadest part, it is only 280 miles wide. Illinois and England are about the same size. Building railroads there was a different thing from building them here. Their profits naturally go toward perfecting their plants, as ours have gone toward lengthening our systems out into the West. Our railroads have mainly developed their own business, while theirs had their business already developed and awaiting them. Then only think what the English business is as compared to ours. England in 50 years has built only 18,000 miles of railroads, but in 1882 those roads carried 563,000,000 passengers. We in 50 years have built 150,000 miles of railroads, but in 1885 we carried only 351,000,000 passengers. In those facts and figures lies reason enough for the superiority of the English railroad plant. Give us the same conditions and we will do as well, but it will take time to bring about such conditions.

[In the calendar year 1889 the total passengers carried by all the railways of Great Britain and Ireland was 750,000,000. In the fiscal year 1889, according to Poor, United States railways aggregating 152,689 miles carried 495,124,767 passengers, not including the traffic on the elevated railways. But on the other hand the total passenger mileage of the United Kingdom was but 6,000,000,000. The United States passenger mileage in 1889, according to Poor, was 11,965,726,015, or nearly double the English.—ED.]

Is it true that there is faster traveling in England than here? Yes, there are faster trains and more of them. The run from London to Liverpool is 200 miles, and it is made in 225 minutes, or at the rate of a mile in a minute and 27 seconds, which, when the stops are taken into account, is very nearly an average of a mile a minute. The run to Edinburgh on two railroads is made in the same time. These are world-famous instances, but they are by no means the only ones. The expresses to Brighton made as good time, and I more than once timed the trains I rode in to other points, and found them making occasional miles at that speed. The beauty of it is, where you have such roadbeds, that the sensation of traveling at such speed is not unpleasant, except when curves are rounded. How very much less unpleasant the same journeys would be if made in our splendid passenger coaches I can only conjecture.

Improvement of Aransas Pass, Texas.

A plan for the improvement of this pass of a somewhat novel type has been suggested by Mr. WM. M. DOUGLASS, to give 24 ft. of water instead of less than 12 ft., and is illustrated in the accompanying map and profile of the jetties. The general idea is, instead of using solid jetties, to use overlapping distinct jetties, so constructed that the outer flaring ends of each begin about 2 ft. above the bottom, and gradually rise until opposite the easterly end of the inner jetty, whence they continue out



Proposed Plan for Improving Aransas Pass, Texas.

seaward at full height. Mr. DOUGLASS' statement of the reasons for and advantages of this construction is as follows:

The plan proposed (explained in part by the accompanying cut) has in view:

1. The holding in position of the present arc of the bar and the cutting of a navigable channel through it.

2. The regulation of the pass from the seaward entrance up into the bay above the lighthouse.

The method devised is essentially the jetty system, applied to meet conflicting conditions of inflow and outflow.

It does not appear that the engineers have heretofore taken into consideration the fact that this pass admits water during flood tide to Corpus Christi Bay, which is not returned to the Gulf by way of Aransas Pass. Also, it seems that the relatively small cross-section up the pass did not appear in any way detrimental to the flow of flood up into Aransas Bay, or injurious to the "gorge" at the immediate entrance during the passage of ebb from Aransas Bay. In my opinion, it is very necessary in planning a project to consider the question of flood entering Corpus Christi Bay by way of Aransas Pass, the bulk of which is not returned to the Gulf by the same route, and also the question of widening the pass between harbor and St. Joseph's Islands, so that the flood may be diffused in such a manner as to more readily fill the bay, while the ebb may be concentrated at the point where the equilibrium for bar formation should be overcome by a preponderance of ebb over flood currents. Sand thus removed, especially by action of the tide, will be distributed (in case Maj. ERNST'S straight and solid jetties are used) not only in front of the jetties but over the area upon either outer side of the works, which sand will be augmented from time to time by material brought into the angles made by the jetties and shore lines by literal currents. Thus in time the outer angles (*N* and *S*) will become filled up and the fore shores thus formed will tend to direct the usual current which draws the sand forward into the zone of accretion, where equilibrium of forces will reconstruct the bar.

The plan I propose considers the importance of adapting the works to either a large or small inflow, or a violent or feeble outflow, without hurtful effect at any time. It is a plan thoroughly conservative, and such as will minimize the evil effect of any forcing process (inherent in a narrow entrance between high jetties) and aid irregular action and feeble flow (necessarily confined to a channel between jetties at a great distance from each other) to which any works may be subjected if applied at this entrance.

It is very probable that the lengths of works, as shown, may be shortened A preliminary survey must determine this before beginning the work. The principal object in view is to secure a form of work which, while it conserves the needful flow by suitable contractions, will hinder the forming of extensive fore shores on the sea sides of the jetties and the drawing out of the sand to form a new shoal at the head of the jetties by the currents projected around the curves formed by the coast and jetties.

The system here presented might be termed the compound jetty system, for the reason that it combines the parallel and converging types, and unites for practical purposes only the best characteristics of these systems. For the reason that flood tide invariably crosses the bar over the area *N* at the beginning, and that northeast winds drive a considerable amount of water into the bays, and that a large amount of sand is also carried into the pass by the flood current, and that southerly and southeasterly and easterly winds cause heavy seas upon the area *S*, with consequent disarrangement of the bar shoals, the prolongation of the works in the curved eastwardly direction has been given as the most conducive to good results in every way.

The idea is to improve the pass by a private company, work to begin within one year, and the company to expend at least $300,000 until 20 ft. of water is obtained, 15 ft. being obtained within three years and 20 ft. within five years, the Government being authorized to take the works off the company's hands at their "value," whatever that may mean, but not being under any obligation to do so. No tolls are to be collected, and local interest is what is relied on. The bill authorizing the work on this basis passed the House unanimously in May last, and we believe is now a law.

The Maintenance of Track.*—Part I: Roadbed.

MATERIAL, SIZE AND SHAPE.

The roadbed is the foundation upon which is built the superstructure or track. If the foundation is defective, its imperfections will develop a rough riding and dangerous track. The *material* of the roadbed is therefore of first consideration. This should be, in all cases, the best soil or earth obtainable in the locality—soil that will hold its position, become compact, resist the erosive action of storms, and, at the same time, possess a degree of elasticity The practice of rolling logs into a roadbed is pernicious, as the logs will decay and allow of sudden and dangerous pitfalls; large rocks or boulders are also objectionable, as they allow an uneven and rigid bearing, and permit the too free percolation of water that, in time of heavy rains, may develop a washout; clay and sand, in about equal quantities, generally give the most satisfactory results. The *size* and *shape* of the roadbed will be determined by the importance of the road and the character of the material; as a general rule, however, it should never be narrower at the top than 6 ft. added to the gauge of track, and generally should be 8 ft. added to the gauge of track for single track roads. The slope of embankments should be made at an angle of 1½ ft. horizontally to 1 ft. vertically, and a space of at least 3 ft. of the natural earth should be left between the base of embankment and the inside edge of side ditches. This space is called the berme, and the importance of keeping this berme intact is too frequently disregarded by trackmen, who cut it out to "build" their "banks." Under no circumstances should it be cut, as such a practice not only injures the stability of a bank, but the earth thus borrowed soon washes back and the permanent improvement of the roadbed is not secured.

ORDINARY DRAINAGE.

Drainage of the roadbed is the process of preventing its saturation and erosion by water. The necessity for thorough drainage is conceded by all railroad men, but, owing to the expenses attendant upon the complete drainage of a roadbed, is too often neglected until a disastrous washout calls for vigorous protective measures in that direction. Ordinary drainage is provided by a system of side ditches, surface ditches, ballast and the improvement of natural water-ways; extraordinary drainage by special methods to suit particular obstacles to be overcome. Side ditches should be straight with a uniform gradient toward their outlet. It is not customary nor expedient to make side ditches of sufficient capacity to provide for the largest recorded rainfall, as, in such cases, ordinary prudence would dictate the suspension of traffic, and the construction of such ditches would entail useless expense upon the road; but it is essential that side ditches should be so made as to provide for carrying off, with greatest directness and rapidity, all of the water falling within 40 ft. of the rail, and beyond that limit surface ditches should be provided. In alignment, side ditches should conform generally to the alignment of the road, and should not be deviated around stumps, boulders, etc., as such obstructions decrease very considerably the efficiency of the ditches, besides detracting from the good appearance of the road; therefore such obstacles should, in all cases, be removed, and the ditches made straight, except where they emerge from a cut and join the ditches along an embankment; in such cases, they should be connected by a ditch of gentle curvature, and, at such connecting ditches, the earth removed in their construction should form a dam on the side toward the roadbed, to prevent the water from the cut overflowing the ditch and damaging the embankment at such points. Side ditches along embankments should be made of a cross section shown in Fig. 1, the bottom of

FIG. 1.

ditch made to slope away from the road, as any wash will then occur on the side of the ditch where the water is deepest, and away from the road. In cuts, a suitable form for side ditches is shown in Fig. 2.

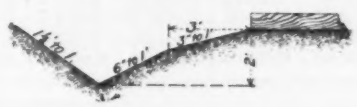


FIG. 2.

In all cases, ditches must be maintained to a depth of at least 2 ft. below the level of the bottom of cross-ties, as an earth roadbed will absorb water to the height of 2 ft. by capillary attraction. Ditches should gradually increase in size toward their outlet. Surface ditches should be constructed on all slopes that tend toward the roadbed in cuts. Such surface ditches should be made of the same general cross-section as the side ditches along embankments, except that the earth should all be thrown on the side of the ditch toward the roadbed. This is to afford ready access for the water coming from the slope, and to prevent overflowing on the side of the road. This is a precaution too frequently neglected. The surface ditches should be sufficient in size in all cases, to carry off the rainfall from the slope on which they are dug, and should be straight and free from obstructions, increasing in size toward their outlet, which should be directed into the nearest natural water-way. On new roads, particularly if they have been hastily built, the track forces should watch with special vigilance during storms, as some weakness of the drainage system is almost sure to exist, and will develop at such times. In case they find the quick construction of a certain ditch necessary, it should be started at the lower end, as it will thus drain itself as it is made. Some foremen will persistently start their ditches at the highest point; thus their work is constantly covered with water, and is far more difficult of execution.

BALLAST.

Where an earth roadbed is in a saturated condition, either by absorption from standing water, by capillary action, or by excessive rainfall, the constant passage of trains will cause the track to sink in the wet earth and "churn," resulting in a rough-riding track. To provide against this, as well as to prevent the "heaving" of track by frost in winter, a layer of porous material called *ballast* is introduced between the ties and roadbed proper; thus the weight of passing trains is distributed uniformly over the entire surface of the yielding roadbed, producing a uniform surface under all circumstances. Stone broken uniformly into cubes of about 1½ ins. on the side, clean gravel, furnace slag, clay burned with coal into hard lumps from 1 in. to 2 ins. in diameter, and coarse sand are valuable for ballast in the order named. The last, however, is exceedingly dusty, and is of too fugitive and unstable a character to answer for good ballast. Broken stone has the advantage of freedom from dust, dirt, weeds and grass. Broken stone and gravel also *wear* much better than either furnace slag or burnt clay. To ensure a good track, ballast should be uniformly placed for a depth of at least 1 ft. below the ties. Probably the ideal ballast is a layer of broken stone from 8 ins. to 1 ft. thick on the roadbed, and a layer of from 4 to 6 ins. of gravel above the broken stone, and immediately under the ties. This ensures perfect drainage, and renders the track easy to keep in surface. The top of roadbed, under the ballast, should always slope both ways from the center, in order that the water filtering through the ballast will pass off immediately into the side ditches, and not stand to saturate the roadbed. See Fig. 3.

FIG. 3.

On very many of our important roads ballast cannot be obtained except at such an expense as to be prohibitory. On such roads, it is all the more important to secure perfect drainage in other ways. Fig. 4 shows a good form of roadbed with dirt ballast.

FIG. 4.

The top of roadbed should slope both ways from the center of track to the bottom of the ends of cross-ties, to afford an opportunity for rain-water to run off rapidly to the side ditches instead of penetrating and saturating the roadbed. Of course this is only a partial remedy, as the roadbed will ultimately become saturated with continuous rains. The surface of such track should never be broken during rainy weather, as the looser the earth the more rapidly it absorbs the water. After continuous rains, the earth of a roadbed frequently becomes so thoroughly saturated with water as to render it unfit for tamping under the churned ties; in such cases it becomes necessary, in the absence of ballast and dried earth, to use some other coarse material as a temporary substitute until dry weather; ordinary grass sods, long coarse grass, or even the brush from tree tops, particularly the pine, may be tamped under the ties, and will sustain the track at soft spots in passable condition for a considerable length of time. The writer uses this method with very satisfactory results during excessively wet weather.

The next element of ordinary drainage is the improvement of natural water-ways, which constitute the main arteries of a drainage system. The small natural streams should be examined for a considerable distance above and below a road, and all obstructions that tend to affect the natural flow of the water should, as far as practicable, be removed; old timber from bridges, logs and other débris should never be allowed to obstruct these streams.

EXTRAORDINARY DRAINAGE.

The protection of slopes and banks is an important feature. Generally some short, creeping, long-rooted variety of grass will be an ample protection for slopes and banks, both from the effects of rainfall and of flowing water. It frequently becomes necessary, however, to furnish additional protection at abutments and along embankments where there is a swift-running stream. Rock revetments or "riprap" can be employed to good advantage in such places, or, in its absence, a wooden revetment or walling made of old bridge timber is a good substitute. This walling should project into the trestle opening at least 6 ft., so that the current passing around the corner of the revetment walling will form an eddy sufficiently far from the abutment not to undermine it. In severe storms, where

*From an essay by H. W. REED, M. Am. Soc. C. E., written for the Association of North American Railway Superintendents.

revetments have not been built or have been washed out from any cause, a good temporary substitute for the protection of the bank is found in tree-tops or large bushes, placed so that the bushy ends of limbs will spread over the side of bank as deep as water is possible, the butt ends being laid in a direction up stream against the top of bank, and held in that position by timbers or earth piled on them. Frequently springs occur in the roadbed in cuts; these can generally be sufficiently drained by means of porous drain tile run at right angles to the line of track and about 2 ft. below the ties, the ends opening out into the open side ditches. Sometimes, however, it becomes necessary to excavate a considerable opening in the roadbed for several feet below the ties and out to the side ditches, filling the bottom with coarse rock and the top with sand or gravel.

One case of peculiar difficulty met with in the writer's experience is as follows: A clay cut about 20 ft. deep and 300 ft. long, at a point that was formerly the head of a small natural drain, gave a great deal of trouble during wet weather by the slope on one side sloughing off and falling in, causing the track to rise suddenly, sometimes as much as 3 ft. in one night. Tons of this earth were removed as it fell in, until the earth from that side of the cut had been removed some 70 ft. from, and to a level with, the road; still the difficulty was not overcome. Open ditches were powerless to reduce the saturation of the semi-liquid mass. Tile drainage was proposed, and a tile drain 6 ins. in diameter was carefully laid parallel with the track, 4 ft. from the ties and 3½ ft. below the level of the track, on the side where the sloughing occurred; and an open ditch was dug on the opposite side of the track. The first wet spell after this the track again began to rise and had to be cut down, and the open ditch re-opened repeatedly. The tile drain was broken up by the movement of the earth, and parts of it found to have passed entirely under the track into the ditch on the opposite side. Soundings indicated that the soft mass extended about 30 ft. below the track, and was apparently slipping over a strata of hard clay with an inclination toward the track. A row of round sheet-piling was driven about 8 ft. from the track and 20 ft. deep. It was intended to brace this piling by means of struts under the track and against the opposite wall of the cut, which stood immovable; but a season of heavy rain coming on prevented the execution of this

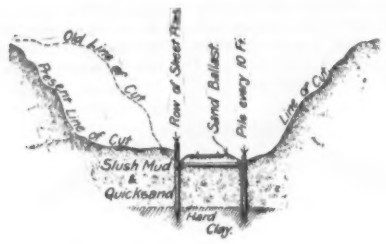


FIG. 5.

part of the work. It was expected that the earth would force the piles toward the track, and that the old difficulty would again reappear. Such was not the case, however; notwithstanding months of heavy rains the piling and track stood immovable, and the problem was solved. Fig. 5 shows a cross-section of this cut.

Calking Lead Joints.

The lead joint when properly made is considered by all authorities to be the best yet devised for water, gas and oil pipes. Although in the recent laying of natural gas mains in Detroit and elsewhere in the West the screw-joint wrought iron pipe has been used, it is hardly probable that this will succeed the lead joint in popular favor. The writer was informed by one of the skilled laborers employed on a line where both the screw and lead joint were used that in a test of about 200 pieces of each—the only test made on the entire line—it was found that 80 joints of the screw pipe leaked, while not a leak was developed in the lead.

In the lead joint a great deal depends upon the skill of the workman who does the calking. Anybody can pound lead, but anybody cannot make a tight joint. In making lead joints on oil and gas lines little or no yarn is used, but in water it is customary to fill from one-quarter to one-half the bell with yarn, as it has been found that 2 ins. of lead well driven is ample to withstand any ordinary pressure. The yarn put in should be rammed in solidly with the yarning iron. If the joint be very cold or at all damp it is always a good plan and sometimes a very necessary one to pour in a little oil. The heavier the oil the better. This prevents the lead chilling too soon and also prevents its spattering into the face of the man pouring. The opening of the joint may be closed for pouring either by a rope rolled in wet clay or by some one of the patent jointers. The latter consist of a rubber band on the inner side of an inclosed hoop of spring steel. At the ends of the hoop are riveted two lugs by means of which either with a clamp or tongs the jointer is closed around the pipe. A small piece of clay is used as a gate around the opening between the ends of the band which allows of pouring. The rubber should be kept well smeared with clay and when so used will last for the pouring of from five to six miles of pipe.

The use of the jointer will be found quite economical, as it saves the services of the boy who makes the rolls, and a joint having been run with a jointer on requires less time to calk than one where the roll is used. The tongs will be found much more serviceable than the clamp, although we have not yet been able to find a house which furnishes tongs, but always have to take clamps and have the tongs made by a blacksmith.

The pouring having been successfully accomplished, the calking proper begins. A good calker will always calk the bottom of his joints first, because it is more difficult to do a good job there, and if the top is calked last the spigot is forced down against the lead at the bottom, so tightening the joint there. In nearly 20 miles of pipe where this rule was followed, although leaks were occasionally found on the top and upper sides, not one was found on the bottom. If a joint leaks on top it is a very easy matter to drive the lead a little more and usually to close it up, but a leak at the bottom is much more difficult to get at. This is one of the best tests we know of of the ability and experience of a calker. Another good test is to have a man acknowledge that he cannot tell by looking at a joint whether it will hold or not. If a man says that he can it can generally be relied upon that he has not seen a great deal of work tested.

The tools used in calking are the yarning iron, having an edge about 1-16 by about ⅜ ins., a cold chisel to cut off the superfluous lead and to start up a tight joint, and from four to ten sets varying in thickness from 1-16 to ¾ in., and about ⅜ ins. broad at the face. Some calkers prefer those with the offset, others those with the single bend. The hammer used should weigh 1¾ to 2¼ or 3 lbs., and should not be over 10 ins. in length over all.

In calking the joint there should first be used a narrow tool next to the spigot, then one a size wider, and so on until one is reached which about fills the joint and leaves a smooth face to the lead. In this way the lead is forced into the recess in the bell and is also thoroughly consolidated next to the spigot. If the joint was not run full so that the lead drives back away from the reach of the tools the joint must be run over again, and under no circumstance in a case of this kind should a cold lead plug be put in. If, however, there is some one point where the joint failed to fill at the front and is filled behind, it is then admissible to put in a plug of cold lead, a chisel having been driven into the lead in the joint to form a cavity for the union of the two pieces of lead, but a plug should never be inserted against a flat surface of lead. It must always go in like a wedge in order to be reliable.—*G. S. Williams, in The Technic for* 1890.

Operations of the Yonkers (N. Y.) Water-Works.

The accompanying table of statistics relating to the Yonkers water-works is taken from the last annual report of the Board of Water Commissioners, and presents in a compact form the operations of the works for nine years. It should be noted that the figures for the years 1885 to 1888, inclusive, are omitted from the table.

The growth of the works is well shown by the total pumpage, receipts, and the extent of the distribution system for each year. The decrease in the operating expenses and interest charges has been great and indicates good management. The total cost of water the first year was extremely high, 40 cents per 100 cu. ft. This high cost was evidently due to getting the works in operation, for the next two years show a cost of but about 19 cents per 100 cu. ft., while in 1889 the cost had been reduced to 8.06 cents per 100 cu. ft., or 10.7 cents per 1,000 galls. With the reduction in cost the revenue per 100 cu. ft. has increased from 4.76 cents in 1877 to 7.41 cents in 1889. This increase is due to an allowance for hydrant rentals, which began in 1890, and, probably, also to the increased use of meters, as very little water was metered at the start, while nearly half of the amount pumped was metered in 1889. During these years the domestic meter rates per 100 cu. ft. measured have increased, while the special meter rates have diminished, as shown by the table.

Such statistics as these are valuable, as showing the cost of water and the revenues therefrom. We wish that more towns would publish such figures, as they furnish valuable means of comparing the efficiency of various works.

YONKERS (N. Y.) WATER-WORKS.

STATEMENT OF WATER PUMPED, HOW DISTRIBUTED, COST, RECEIPTS AND DISTRIBUTION.

Fiscal year of	Cubic feet of water pumped, measured at pump.	*Cubic feet of Water Distributed.* Not Metered.	Metered at Domestic and Special Rate.	Metered at Domestic Rate.	Metered at Special Rate.	Metered, New York City Contract.	*Cost of Water.* To pump. Total $	To pump. Cents per 100 cu. ft.	To pump and distribute. Total $	To pump and distribute. Cents per 100 cu. ft.	To pump, distribute and pay interest. Total $	To pump, distribute and pay interest. Cents per 100 cu. ft.
'77	13,728,788	10,790,308	2,938,480	749,181	2,189,290	.....	2,950	2.15	11,210	8.17	54,961	40.00
'78	27,872,440	22,201,588	5,670,852	1,165,444	4,505,408	.....	2,914	1.05	9,261	3.00	53,011	19.02
'79	26,415,525	15,896,261	10,519,264	1,721,725	8,797,539	.....	2,841	1.07	7,696	2.91	51,446	19.46
'80	43,205,478	29,068,722	13,995,276	2,359,840	11,635,436	141,480	4,093	0.95	9,463	2.19	53,213	12.32
'81	41,742,494	23,232,492	17,230,280	2,450,986	14,779,294	725,960	4,597	1.10	10,494	2.51	55,494	13.30
'82	51,274,000	26,172,987	23,435,653	3,689,817	19,745,836	1,665,360	5,781	1.13	12,100	2.36	57,350	11.19
'83	60,812,663	36,107,858	21,839,885	4,776,941	17,062,944	2,864,920	6,681	1.09	14,474	2.38	63,024	10.36
'84	62,295,076	37,517,766	21,291,660	6,553,656	14,738,504	3,485,650	8,428	1.35	17,491	2.81	66,118	10.61
'89	98,408,415	45,010,152	19,232,323	17,007,635	32,224,688	4,165,940	13,057	1.33	27,058	2.75	79,308	8.06

Fiscal year of	*Receipts for Water.* Including hydrant payment. Total $	Including hydrant payment. Cts. per 100 cu. ft.	Not including hydrant payment. Total $	Not including hydrant payment. Cts. per 100 cu. ft.	Not metered, including hydrant payment. Total $	Not metered, including hydrant payment. Cts. per 100 cu. ft.	Not metered, not including hydrant payment. Total $	Not metered, not including hydrant payment. Cts. per 100 cu. ft.	Metered domestic and special rate. Total $	Metered domestic and special rate. Cts. per 100 cu. ft.	Metered domestic rate. Total $	Metered domestic rate. Cts. per 100 cu. ft.	Metered special rate. Total $	Metered special rate. Cts. per 100 cu. ft.	Metered New York City contract. Total $	Metered New York City contract. Cts. per 100 cu. ft.	Miles of mains, Dec. 1, 1889.	No. of gates, Dec. 1, 1889.	No. of hydrants, Dec. 1, 1889.	No. of taps and connections, Dec. 1, 1889.	Meters, Dec. 1, 1889.
'77	6,530	4.76	6,530	4.76	3,976	3.69	3,976	3.69	2,554	8.76	1,126	15.02	1,428	6.52	.....	.....	21.9	139	230	352	164
'78	7,942	2.85	7,942	2.85	3,669	1.65	3,669	1.65	4,273	7.53	2,168	18.60	2,105	4.67	.....	.....	22.3	141	236	471	238
'79	11,090	4.20	11,090	4.20	4,560	2.87	4,560	2.87	6,330	6.21	3,285	19.09	3,245	3.69	.....	.....	22.4	142	238	632	318
'80	21,261	4.91	14,061	3.25	13,010	4.47	5,910	2.03	8,151	5.83	4,494	19.04	3,657	3.14	804	56.76	23	148	246	782	402
'81	26,458	6.33	19,078	4.57	14,155	6.10	6,755	2.92	10,751	6.24	6,007	22.67	4,744	3 21	1,221	16.80	23.4	154	250	947	496
'82	32,587	6.36	25,067	4.89	14 943	5.53	7,443	2.84	15,273	6.52	8,356	22.65	6,917	3.50	2,370	14.23	24.5	163	263	1,133	605
'83	37,578	6.18	29,683	4.88	15 967	4.42	8,077	2.24	17,314	7.93	10,508	22.00	6 806	3.99	4,297	15.00	28.7	186	310	1,344	732
'84	44,227	7.10	34,927	5.67	18.326	4.88	9,026	2.41	20,672	9.71	14,185	21.65	6,487	4 40	5,228	25.00	31	208	331	1,534	914
'89	72,956	7.41	61,346	6.23	19,C12	4.35	8,002	1.79	47,929	9.73	36,569	21.05	11,360	3.52	5,416	13.00	36.5	218	412	2,503	2,039

Ten-Wheel Locomotive—Canadian Pacific Ry.

(WITH INSET.)

On our inset sheet this week we illustrate a novel ten-wheel locomotive in use on the Canadian Pacific Ry., designed by Mr. F. R. F. BROWN, late Mechanical Superintendent of the Canadian Pacific Ry., and built at the Montreal shops of the company. For the drawings and description of the locomotive we are indebted to *Engineering*, of London.

The most striking feature of the engine is the very short wheel base, for a 10-wheel engine, of less than 23 ft. The truck wheels are 30 ins. in diameter, steel tired, and the driving wheels are 75 ins. in diameter. It is apparent from this that the engine is built for high speeds, and it has been used chiefly for fast passenger runs. The wheels are crowded unusually close together, also, although it is modern practice with 10-wheel engines to put the wheels as close together as possible. The new Erie 10-wheel engines built by the Baldwin Locomotive Works have drivers only 68 ins. in diameter, against 75 ins. on this engine, yet its wheel base is 24 ft., or a foot more than the Canadian Pacific engine. The front pair of drivers are flangeless, and thus, as far as flange resistance is concerned, the engine runs around curves as easily as an American type (4-driver) engine. The flangeless tires on the front drivers are 6 ins. face, so there is no danger of their dropping off the rail on sharp curves.

The frame of the engine presents some novel features. The projection of the frames in front of the cylinders is short, as in an English locomotive. This makes a very stiff front end and avoids the use of the smoke box brace, which is practically a universal feature of American locomotives. This construction seems on the whole to be a stronger and cheaper one than that usual on American engines. The frames are forged solid from the back end to the front of the leading drivers. The two bars embracing the cylinders are connected to the main frame by spliced and keyed joints. The arrangement of springs, spring hangers and equalizers is an ingenious one, and is especially good, because of the ease with which the springs may be reached for inspection or repairs. The driving boxes are cast steel with brass liners to prevent cutting the bosses on the wheel centers.

The boiler is made to carry a pressure of 180 lbs., and has a total heating surface of 1,491 sq. ft., and a total grate area of 25.3 sq. ft. The exhaust nozzle is single, and arranged with netting, etc., in the extension front end in about the usual manner. The boiler and fire-box plates are of open-hearth steel, imported from Scotland. The shearing, punching and riveting on the boiler was done by Tweddell's hydaulic machinery. The rivets and stays are extra mild steel.

The cylinders are 20 × 22 ins. The steam ports are 18 ins. × 1⅛ ins. and the exhaust ports are 18 ins. × 3⅛ ins. It will be seen that with these dimensions of cylinder and drivers the high speed of 60 miles per hour would give the comparatively low piston speed of 986 ft. per minute. The Delancey balanced valves are used and the United States metallic packing is in use on both the piston rods and valve stems.

The grate is inclined toward the front of the box and the grate bars rock in two sections. The ash-pan and grate carriers are supported from the foundation ring.

The engine is fitted with Westinghouse automatic brake apparatus, with a separate reservoir for the engine and a brake shoe on each driving-wheel. Feed water is supplied by two Gresham & Craven injectors and sight-feed lubricators are used.

Perhaps the most novel feature of the engine is the cab, which is built of steel plate, No. 10, I. W. G., with butt joints and countersunk rivets to give a smooth exterior finish. To secure warmth the cab is lined with wood and an air space of 1½ ins. is left between the plate and the wood. This is probably the first steel cab of this style ever built in North America.

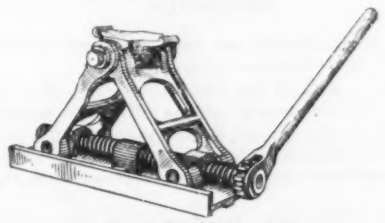
The nearest approach to this engine in general design which we now recall is the 10-wheel engine above referred to, built by the Baldwin Locomotive Works for the New York, Lake Erie & Western R. R. To show how these two engines compare we give the general dimensions of both in the following table:

	Can. Pac. 10-wheeler.	N. Y., L. E. & W. 10-wheeler.
General Dimensions.		
Total wheel base	22 ft. 11 ins.	24 ft.
Driving wheel base	13 ft. 3 ins.	13 ft. 6 ins.
Spread of truck wheels	5 ft. 3 ins.	5 ft. 8 ins.
Total length of engine	37 ft. 10¼ ins.	37 ft. 1¾ ins.
Height above rail	15 ft. 1 $\frac{9}{16}$ ins.	15 ft. 11 ins.
Weight in working order	107,000 lbs.	130,000 lbs.
Weight on drivers	84,000 lbs.	100,000 lbs.
Cylinders, Wheels, etc.		
Cylinders	20 × 22 ins.	20 × 24 ins.
Driving wheels, diameter	75 ins.	68 ins.
Truck wheels, diameter	30 ins.	33 ins.
Slide valves	Delancey balanced	Richardson balanced.
Driving axle journals	7 × 8 ins.	7⅛ × 8½ ins.
Truck axle journals	5 × 8 ins.	5 × 10 ins.
Boiler.		
Outside diameter smallest		
Boiler rung	54 ins.	60 ins.
Tubes	204-2 ins.	275-2 ins.
Tube length	11 ft. 11 ins.	12 ft. 2 ins.
Fire-box: length inside	8 ft. 7⅛ ins.	11 ft. 7 16 ins.
" width inside	40 ins. (ave. of bottom and top.)	43 ins.
" depth inside	52⅛ ins. (ave. of front and back.)	58 1-2 ins.
Heating surface fire-box	120.4 sq. ft.	186 sq. ft.
Total heating surface	1,491 sq. ft.	2,061 sq. ft.
Grate area	25.3 sq. ft.	40.7 sq. ft.
Boiler pressure	180 lbs.	160 lbs.
Capacity of tank	3,350 galls.	3600 galls.

From the above table of relative dimensions it appears that the Erie engine is a much larger and heavier machine. The Canadian Pacific engine, which we illustrate, is evidently designed for a lighter traffic over more moderate grades at very high speeds. Whether the 6 coupled locomotive is the coming machine for fast express traffic, however, is a question which is still unsettled, and is likely to be for some time. We hope to give some further particulars of the Canadian Pacific 10-wheelers in an early issue.

The Fisher Duplex Track Jack.

The horrible disaster of last week on the Old Colony R. R. has emphasized the fact that there is a serious element of danger in having track jacks in use which project above the rails, and if not removed in time become dangerous obstructions. To



The Fisher Track Jack.

obviate this difficulty, Mr. CLARK FISHER, proprietor of the Fisher Rail Joint Works of Trenton, N. J., devised some years ago the jack illustrated herewith, which we have never before illustrated, although it has met with considerable favor.

This jack is entirely below the rails, and is capable of carrying 15 tons with safety, although weighing only 30 lbs. It is, therefore, quite unnecessary to remove it from beneath the rails to avoid a wreck, although we fancy that the jack might in casesgive a fast train a rather unpleasant jolt. The base-plate is 16 × 5¼ ins., and carries a 1¼-in. right and left screw worked by a ratchet, as shown, the total height of the jack being only 7 ins. when in its lowest position. The screw and bed plate are of cast iron, and all the other parts cast steel.

The Duties of a City Engineer.

The ordinance here given, defining the duties, fees, etc., of a city engineer in what may be called cities of the second class, will doubtless prove interesting reading to a number of our subscribers, though its form may require modifications to adapt it to local conditions, elsewhere. It is an ordinance just passed by the Councils of Salt Lake City, Utah, and is given in full as follows:

SECTION 1. There shall be appointed on the first Tuesday of April, 1890, a City Engineer, whose term of office shall be two years, and until his successor in office shall have been duly appointed and qualified.

Sec. 2. Before entering upon the duties of his office the City Engineer shall give a bond in the sum of $5,000 for the faithful performance of his duties.

Sec. 3. It shall be the duty of the City Engineer to locate the lines and grades of all streets and sidewalks, alley, avenues or other public ways, and to determine the position, size or construction of all sewers, waterwork, irrigation or drainage canals, reservoirs, culverts, conduits, aqueducts, bridges, viaducts or other public work or appurtenances, and to prepare plans, maps or profiles of the same, and to make estimates and furnish specifications for any of said work whenever required to do so by the Mayor or City Council. He shall have general supervision of all contract or other work, and see that it is performed in a workmanlike manner and in accordance with the authorized plans, and in conformity with the terms of the contract an specifications.

Sec. 4. It shall be the duty of the City Engineer to make, as soon as the time and means at his command will allow, a complete resurvey of the entire city, including all streets, sidewalks, alleys, avenues, public squares, parks and all public or private lands, which shall constitute and be the official survey of the city. And all lines thereby established shall be perpetuated by substantial and permanent stone monuments or otherwise as the City Engineer may determine.

Sec. 5. As the work of the resurvey of the city progresses, a corrected map of the official survey shall be made, showing all streets, alleys, avenues, or other public ways, also all public squares, parks, public buildings and lands and all prominent and permanent topographical features within the city limits, and said map shall be corrected from time to time to conform to such changes as shall be made.

Sec. 6. The city engineer shall keep in his office certified copies of all the field notes, maps or profiles which relate to the city surveys, water-works, sewers, irrigation system, streets or sidewalks, and to all other engineering works, and he shall arrange and index them in such manner as will enable a ready reference thereto, and all shall be the property of Salt Lake City.

Sec. 7. As soon as the official survey, hereinbefore authorized, shall have been extended over any portion of the city, it shall be unlawful for any person or persons to commence the erection of any building upon the line of any street or public highway, embraced within the limits of such survey, without first applying to the city engineer for the line and grade of such street or highway, and thereupon it is made the duty of the city engineer to establish the required line and grade before the erection of such building shall have been commenced. And if any person shall violate any provision of this section he shall, upon conviction, be fined not less than ten nor more than fifty dollars.

Sec. 8. The City Engineer shall be allowed to charge and demand in advance, for the benfit of the city, the following fees from the owners of property ordering work to be performed, or against whom the work is properly chargeable. In all parts of the city over which the official survey shall have been extended, or when the surveys are found to agree substantially with the recorded plats thereof.

For surveying each lot having more than 25 ft. and not exceeding 60 ft. front, $5.00.

For each additional lot of the above dimensions, contiguous thereto and owned by the same party, $2.50.

For surveying each lot having not over 25 ft. front, $4.00.

For each additional lot of the last above dimensions, and belonging to the same party, $2.

For establishing street and sidewalk grades for any frontage not exceeding 60 ft., $4.

For establishing street and sidewalk grades for any frontage over 60 ft., and not exceeding 100 ft., $5, and for each additional foot 5 cts. per lineal foot.

Sec. 9. In all parts of the city over which the official survey has not been extended, and where the surveys are not found to agree substantially with the recorded plats thereof, the City Engineer shall for all surveys in such districts charge and collect in advance a sum estimated to cover the proper cost or expense thereof, and upon ascertaining such cost or expense, any excess thereof shall be refunded to the applicant; and in case of surveys in such districts where lines cannot be satisfactorily determined to agree with the recorded plat, the City Engineer may refuse to give any certificate of survey.

Sec. 10. The City Engineer may appoint the following assistants or such of them as may be actually required for service in the City Engineer's Department, who shall be paid while in said service not to exceed the following rates, to wit:

One First Assistant Engineer at $150 per month.
One Second Assistant Engineer at $125 per month.
One Chief Draughtsman at $125 per month.
One Assistant Draughtsman at $100 per month.
Two Rodmen at $75 per month each.
Two Chainmen at $65 per month each.
One Inspector of Sewers at $125 per month.
One clerk at $100 per month, and such other assistants as the necessities of the service may demand to be paid out of the city treasury at the end of each month in which such service shall have been rendered and duly vouchered. Provided that the City Engineer, before appointing any of the assistants enumerated in this section shall submit to the City Council a statement setting forth the necessity for such assistants and the appointment thereof, and obtain the consent of the Council so to do.

Sec. 11. All fees and revenues of whatever kind, received in the department of the City Engineer, and arising from the official acts of the City Engineer or any of his assistants, shall belong to the City of Salt Lake, and the City Engineer shall collect and receive the same and turn them into the city treasury in the manner provided in such cases, and he shall as often as once every three months report the actions and doings of his department to the Mayor and City Council.

Sec. 12. The City Engineer shall devote his personal time and attention to the duties and requirements of his office, and shall receive therefor such compensation as the Mayor and City Council may fix.

Sec. 13. If any person shall interrupt or molest said City Engineer while engaged in his official duty, by riding or driving any horse or animal or vehicle of any kind against the person or surveying instruments or other professional apparatus of said City Engineer or any of his assistants, or by moving or displacing any stake or other land mark fixed or determined by him or his assistants, or by willfully causing or offering them any kind of corporeal injury or hindrance, such person so offending shall upon conviction thereof be fined in any sum not less than $5 nor more than $100.

Sec. 14. The office of City Surveyor is hereby abolished, and the duties of said office as fixed by law and ordinance are hereby imposed upon the City Engineer.

Passed April 1, 1890.

[SEAL.] GEO. M. SCOTT, Mayor.
Attest: LOUIS HYAMS, City Recorder.

UNITED STATES OF AMERICA, TERRITORY OF UTAH, SALT LAKE CITY. } ss.

The Motive Power of City Railways.

From Census Bulletin No. 11, just issued, we extract the following interesting table showing motive power used for operating street railways in 56 principal cities (those having over 50,000 inhabitants). The mileage given is of *line*, whether single or double track, and not of track, the mileage being about equally divided between single and double track, but a much larger proportion of single track being included in the horse car lines than in those operated by power. We have briefly reviewed the statistics elsewhere.

MILES OF CITY RAILWAYS IN 56 PRINCIPAL CITIES OPERATED BY VARIOUS KINDS OF MOTIVE POWER.

[From Census Bulletin, No. 11, extending to Dec. 31, 1889.]

Cities.	Animal power.	Electricity.	Cable.	Steam.		Total miles of line.
				Elevated roads.	Surface roads.	
Albany, N. Y.	13.19	7.25	.....	.....	.....	20 44
Atlanta, Ga.	19.48	1.95	.....	.....	7.50	28.93
Baltimore, Md.	105 81	.....	.....	.....	.....	105.81
Birmingham, Ala.	16.90	.....	.....	.....	60 04	76.94
Boston, Mass.	151 15	49.71	.....	.....	.....	200.86
Brooklyn, N. Y.	132.95	6.30	.....	24 19	1.00	164 44
Buffalo, N. Y.	42.30	.....	.....	.....	.....	42.30
Cincinnati, Ohio	49.72	9.50	12.51	.....	.....	71.73
Charleston, S. C.	19 19	.....	.....	.....	.....	19 19
Chicago, Ill.	160.77	.....	24.01	.....	.....	184.78
Cleveland, Ohio.	40 88	17.82	.....	.....	.....	58.70
Columbus, Ohio.	19.90	0 75	.....	.....	.....	20.65
Dallas, Tex.	16.07	.....	.....	.....	4.00	20.07
Dayton, Ohio.	14.00	4.16	.....	.....	.....	18.16
Denver, Colo.	28.99	4.35	29.62	.....	8.50	71.46
Detroit, Mich.	48.96	12.30	.....	.....	.....	61.26
Fall River, Mass.	11.94	.....	.....	.....	.....	11.94
Galveston, Tex.	32.96	.....	.....	.....	.....	32.96
Gr'd Rapids, Mich.	20.57	.....	4.13	.....	.....	24.70
Hartford, Conn.	16 80	.....	.....	.....	.....	16.80
Indianapolis, Ind.	41.39	.....	.....	.....	.....	41.39
Jersey City, N. J.	20.74	.....	1.40	.....	2.25	24.39
Kansas City, Mo.	10.06	7 50	38 66	5.20	23.46	84.97
Los Angeles, Cal.	34.53	7.50	14.60	.....	25.76	82.39
Louisville, Ky.	69.50	4.00	.....	.....	8.81	82.31
Lowell, Mass.	22.93	.....	.....	.....	.....	22.93
Memphis, Tenn.	52.20	.....	.....	.....	.....	52.20
Milwaukee, Wis.	40.38	.....	.....	.....	5 35	45.73
Minneapolis, Minn	33.50	.....	.....	.....	18.00	51.50
Nashville, Tenn.	14.63	11.10	.....	.....	20.20	45.93
Newark, N. J.	51.57	.....	.....	.....	.....	51.57
New Haven, Conn	20.65	.....	.....	.....	.....	20.65
New Orleans, La.	91.62	.....	.....	.....	12.70	104.32
New York, N. Y.	133.53	.....	6.87	32.40	4.30	177 10
Oakland, Cal.	18 96	.....	2.72	.....	2.32	24.00
Omaha, Nebr.	21.17	23.79	4.46	.....	.....	49.42
Paterson, N. J.	16.00	.....	.....	.....	.....	16.00
Philadelphia, Pa.	260.47	.....	23 00	.....	.....	283.47
Pittsburg, Pa.	34.51	20.30	12.97	.....	.....	67.78
Providence, R. I.	47.48	.....	3.00	.....	.....	50.48
Reading, Pa.	14.10	1 33	.....	.....	.....	15 43
Richmond, Va.	5.65	8 72	.....	.....	.....	14.37
Rochester, N. Y.	32.59	4.70	.....	.....	.....	37 29
St. Joseph, Mo.	1.00	17 19	.....	.....	.....	18.19
St. Louis, Mo.	97 05	1.00	20.70	.....	.....	118.75
St. Paul, Minn.	22.00	.....	10.00	.....	.....	32.00
San Francisco, Cal.	27.33	.....	47.22	.....	13 37	87.92
Savannah, Ga.	8.17	.....	.....	.....	4.25	12.42
Scranton, Pa.	.....	23.82	.....	.....	.....	23.82
Syracuse, N. Y.	30.81	3.88	.....	.....	.....	34.69
Toledo, Ohio.	28.82	2.00	.....	.....	.....	30.82
Trenton, N. Y.	15.50	.....	.....	.....	.....	15.50
Troy, N. Y.	13.48	3.00	.....	.....	.....	16.48
Washington, D. C	35.27	3 50	.....	.....	.....	38.77
Wilmington, Del.	6.12	2.85	.....	.....	.....	8.97
Worcester, Mass.	14.86	.....	.....	.....	.....	14.86
Total	2,351.10	260.36	255.87	61.79	221.81	3,150.93
Per cent.	74.62	8.26	8 12	1.96	7.04	100.00

The percentage of double track in various cities varies greatly. Thus, Philadelphia, which has the largest mileage of line, has only 14% of double track and Boston only 52%, while Omaha has 100% and New York 91½%. The cities having over 100 miles of street railway *track* are, in order: New York, 369; Chicago, 365½; Boston, 329½; Brooklyn, 324½; Philadelphia, 324; then by a great drop in mileage, to Baltimore, 171¾; St. Louis, 165½; New Orleans, 159; Kansas City, 143½; San Francisco, 140; Cincinnati, 131; Pittsburg (and Allegheny City), 118½; Cleveland, 108; Los Angeles, Cal., 105¼; Denver, Col., 101½. That Los Angeles should appear in this list and such cities as Washington, St. Paul, Minneapolis, Milwaukee, Louisville, Buffalo, Rochester, etc., not appear, is surprising, as also that Birmingham, Ala., has nearly enough (91 miles) to appear.

FIRING DYNAMITE SHELLS WITH POWDER does not yet prove sucessful. As described in previous issues of this journal, experiments to this end are being carried on by Dr. JUSTIN near Perryville, Madison Co., N. Y. At the test described in our issue of May 31, the 9-in. Blakely rifle used was blown to pieces by the premature explosion of the dynamite charge. On Aug. 26 another trial took place. The gun used was a 9-in. Blakely rifle that was used in the defense of Charleston. The first shot was a complete success, a 275-lb. shell containing 14½ lbs. of dynamite being fired with 30 lbs. of powder. The dynamite did not explode until the shell struck the target. The next charge was a similar shell with a similar charge, propelled by the same amount of powder. This time the shell exploded in the gun, blowing it into hundreds of pieces. The inventor ascribes the failure to the poor quality of steel in the second shell. The trial has certainly demonstrated that it is possible for a loaded dynamite shell to be fired with powder from an ordinary gun without explosion. It still remains to be seen whether it is possible to fire it in such a manner that there will be much choice as regards safety between standing in front of the muzzle or beside the gun. Perhaps the use of slow burning powder will help in solving the problem.

THE ERICSSON CEREMONIES on Saturday, Aug. 23, were conducted in a dignified and impressive manner, save for the same crowding and confusion in the harbor procession from the wharf to the ship, which made the marine parade of April, 1889, a clumsy farce. In the procession from the cemetery to the wharf, where the remains of the distinguished engineer were taken on board the *Baltimore's* boat, were delegations from the American Society of Civil Engineers, the American Society of Mechanical Engineers and the American Society of Swedish Engineers. While these honors to ERICSSON's memory by the United States government are most appropriate, they are but small amends for the shabby treatment which was accorded him during his lifetime. It is to be hoped that the petition to Congress from the American Society of Mechanical Engineers asking that an appropriation be made for some suitable memorial to the great engineer may yet be favorably acted upon.

WORK ON THE PROVIDENCE, R. I., COVE BASIN is making rapid progress. The filling is now over half completed. The work is being carried on in connection with the new union depot and railway terminal enterprises.

PERSONALS.

Mr. W. H. BURNS, has been appointed General Manager of the Montana Union Ry.

Mr. J. A. FILLEY has left Kansas City, Mo., for Mexico, Mexico, where his address will be Calle Ortega 28.

Mr. EMIL KUICHLING, M. Am. Soc. C. E., has been engaged by the city authorities of Toronto, Ont., as consulting engineer in connection with the proposed sewerage works.

Mr. G. A. RAYMER, Assistant Chief Engineer of the Burlington & Missouri R. R., has resigned in order to accept the position of Manager of the Newcastle, Wyo., Coal Co.

Mr. C. J. WILSON has been appointed Assistant Superintendent of the St. Paul Division of the Northern Pacific R. R.

Mr. F. MERTZHEIMER is reported to be the successor of Mr. R. D. BAXTER as Superintendent of the Wyoming Division of the Union Pacific Ry.

Mr. E. S. HASKINS, recently connected with the Illinois Central R. R., has been appointed Manager of the New Orleans Car Service Association.

Mr. W. H. BALDWIN, Vice-President of the Montana Union Ry., has been appointed Assistant Vice-President of the Union Pacific Ry., with headquarters at Omaha.

Mr. THOMAS SAUNDERS, who recently resigned his position as Superintendent of the Colorado Midland Ry., has been appointed General Superintendent of the Rio Grande Junction Ry.

Mr. M. T. SEYMOUR, formerly President of the Toledo Division of the Columbus, Hocking Valley & Toledo Ry., has been appointed Superintendent of the St. Louis, Alton & Springfield R. R.

MR. JOHN S. WEBB, late Ch. Eng. G. W. Air Line survey from Charleston to Weldon, N. C., has accepted place as Inspector of Masonry on the Elkhorn Division, Ohio Extension, Norfolk & Western Ry.

Mr. C. J. SMITH will, it is said, resign his position as General Manager of the Pacific Division of the Union Pacific Ry. His successor will be General Manager MCNEIL of the St. Joseph & Grand Island R. R.

Col. V. E. PIOLETT died Aug. 27 at Wysox, Pa. at the age of 78 years. He was Superintendent of the North Branch Canal and Superintendent of Construction of the Philadelphia & New York R. R. from 1867 to 1872.

NEW PUBLICATIONS.

BOOKS.

—*Handbuch für den Eisenschiffbau.* Darstellung der beim Bau eiserner und stählerner Handelsschiffe üblichen Constructionen. OTTO SCHLICK. Paper, 8vo., pp. XVI. and 495, with atlas of 27 plates. Arthur Felix, Leipsic.

The author of this work, who is a well known German naval architect and the superintendent of the Veritas shipyards, first gives a description, in 243 pages, of the present German practice in the construction of single screw merchant ships, beginning at the keel and continuing in the regular order in which the work is carried out. The reader is in this way not only made more familiar with the details, but is also saved the annoyance of being at once confronted with a large number of technical expressions with which he is not familiar. The advantages of this treatment are apparent to any one who began his study of the subject in English works. The plates are excellent and give the details of every part of the hull. The special construction of double screw vessels occupies 10 pages, and 28 more are devoted to a description of the various classes of iron and steel ships. The 20 pages given to water ballast are especially interesting. The remainder of the volume is devoted to riveting, specifications for materials and painting. The formulas for riveting are quite complicated and German-like, demanding a theoretical accuracy which cannot be attained by mechanical means. The effect of drilling or punching rivet holes on the adjacent metal depends so much on the kind and condition of the tools employed, that working formulas must always contain a large factor of safety, which renders refinements of calculation of little practical value. Still, the book is the most complete which exists on its subject in any language, the literature of iron ship building being particularly limited in English, and as such it will doubtless be of much interest and value to the builders of steel vessels in this country and to all those who wish to become familiar with their details. The author has confined himself strictly to his subject, and has no where given any account of ship design or of the appliances used in construction. The book is written in a clear style, and not a single integral sign has twisted its way into the pages, a refreshing innovation in a volume of this kind. Typographically the work is unexceptionable, and the lithograph engravings are admirably clear and neat.

—*Whipple's Electric, Gas and Street Railway Financial Reference Directory.* Second year. Cloth, 6¼ × 9 ins., pp. 584. The Fred H. Whipple Co., Detroit, 1890. Price $5.00, or with key to private ratings of the various companies, $10.00.

This Directory evidently aims to give complete information regarding all the electrical interests in North America, and considering the diversity of these interests, and that this is but the second annual issue the aim seems to be well accomplished.

The names and officials of all the electrical and kindred societies are given, as are descriptions of the various central and isolated electric lighting plants, gas plants, street railways, electrical or otherwise. There is also a list of telephone exchanges and licenses for the supply of telephones, and the rules and regulations of the Boston Fire Underwriters' Union, the Electric Mutual Insurance Co., New York Boards of Electrical Control and Fire Underwriters, and the Philadelphia Fire Underwriters' Association.

Under "Gas Light Companies" the various towns in the United States having gas plants are arranged, the name and officials of each works are given, together with the date of holding the annual meeting and the price of gas per 1,000 sq. ft. If electric lights are operated in connection with the gas plant the name of the system is given, and the reader is referred to the list of "Central Electric Stations," where the most of data cited for the gas works is given, and in addition the capital stock of the company, whether all paid, a general description of the system and price of public lamps. Regarding the latter the kind and number of lights paid for, their candle power, and time kept lighted are stated, and also the time of expiration of the contract.

Under "Street Railroad Companies," the various street railways are described in brief, including their length, gauge, weight and shape of rail, number of cars, horses or engines, and length of cable, if it be a cable road. If it be an electric road the system in use is stated. The volume proper closes with an alphabetical list by names and firms and a classified list of the electric trades.

We know of no other publication where so much or so varied information can be found on these subjects. We have not tested the completeness of the various lists but they seem to include everything in their line.

We regret that so much well-arranged and valuable matter has been presented to the public without the slightest attempt at summaries or deductions. The length of the various lists is impressive, but if one wishes to ascertain from the book the number of central electric stations in a State or even in the United States, he must

laboriously count them. The same applies to all the data.

REPORTS.

—*Railway Returns for England and Wales, Scotland and Ireland*, for the year 1889. Pub. Doc. Eyre & Spottiswoode, London. 4to, pp 93, 1 sh.

—*Annual Report of the Board of Public Works of Grand Rapids (Mich.).* FRED A. TWAMLEY, Secy. April 1890. Pamph.

Among the contents of this report we mention quite complete pumping statistics for the year, and data regarding the various kinds of fixtures supplied with water.

—*Annual Reports of the Department of the Board of Public Works, City of New Haven, Conn., for the Year* 1889. ALBERT B. HILL, City Engr. Pamph.

The report contains some interesting figures regarding the cost of crushing stone from 1879 to 1889, inclusive, with the exception of 1885. There is also a valuable table showing in some detail the nature and cost of the work on new sewers in 1889.

—*Fifth Annual Report of the State Board of Health of the State of Kansas*, 1889. J. W. REDDEN, Sec'y, Topeka, 1890. Published by the State. Cloth, pp. 369.

This report contains, in addition to vital statistics and a general review of the work of the board several papers, among which may be mentioned "Sewerage and Drainage of Lawrence," by Prof. F. O. MARVIN, and "Polluted Water," by Prof. F. H. SNOW.

—*Statistics of Railways in the United States.* Second Annual Report to the Interstate Commerce Commission for the Year ending June 30, 1889. Pub. Doc. 8 vo. pp. 45.

This report, advance sheets of which have just reached us, comes out upon the heels of Poor's Manual, and invites a contrast which is made in another column. It also contains valuable statistics never heretofore available which we fully abstract.

—*Report of the Fifth Annual Meeting of the Illinois Society of Civil Engineers held at Peoria, Ill., Jan.* 29-31, 1890. Springfield, Ill., 1890. Pamp., pp. 158. 50 cents.

This report contains 19 papers and 8 "topical discussions." Among the subjects of the papers the most notable are: "Public Roads;" "Municipal Engineering, Including a Description of the Municipal Engineering Features of Springfield;" "Description of the New Water-Works Plant at Peoria, Ill.;" "Ledlie's Proposed Sewerage System for Joliet;" and "The Cairo Bridge and Terminal Facilities."

—*Report of the State Engineer and Surveyor, John Bogart*, State Engineer, Albany, N. Y. Pub. Doc., 8vo. pp. 255, 3 large folding plates.

This is an unusually valuable report technically, being entirely devoted to engineering matters, and containing full reports from the Division Engineers as to the details of the Erie and other State Canals, evaporation, filtration and leakage, locakages, etc. It has been found that by the use of some 50 or 60 cu. ft. of water to create currents, the time of lockage can be reduced from 27 minutes to about 8. Mr. Bogart has some good words to say for civil service examinations when properly conducted, and not merely scholastic.

—*Annual Report of the City Engineer of the City of Providence (R. I.) for the year* 1889. Pamph.

The most noteworthy feature of the report is the register of meteorological observations at Hope reservoir and the City Hall, there being a large sheet for each month giving results of observations at 7 A. M., 1 and 9 P. M. each of barometers, thermometers, humidity, wind weather, rain and snow. This information is properly averaged, summarized and otherwise worked over, and most of it is finally presented for each month as a whole and for each of the years 1881 to 1889, inclusive.

The report contains a brief description of the new Fruit Hill reservoir and memoranda on the inspection of telegraph and telephone poles in use within the city. The latter is interesting and novel and will be commented upon elsewhere in this issue.

— *The Substitution of Metal for Wood in Railroad Ties.* A Report by E. E. RUSSELL TRATMAN, C. E., Together with a Discussion on Practicable Economies in the Use of Wood for Railway Purposes, by B. E. FERNOW, Chief of Forestry Division, Washington. Pub. Doc. U. S. Dept. of Agriculture, Bulletin No. 4. Large 8vo, pp 350, 30 plates.

In the above report prepared for the Department of Agriculture by one of the associate editors of this journal now absent in Europe, a vast amount of information concerning the different forms of railway ties has been compiled, and to one unacquainted with the subject some of the figures given are startling. We abstract from the report quite fully in order to make the valuable figures given more accessible. For instance, the total length of railways throughout the world reported as laid with metal ties of various forms is already about 25,000 miles, only 2 miles of which are reported from the United States.

It is acknowledged in the report that the returns of mileage are incomplete, and in consequence it is estimated that there are in the world at least 30,000 miles of railway laid with metal ties.

In the first 50 pages of the report, the subject of "The Consumption of Forest Supplies by Railroads and Practicable Economy in their use," is treated by Mr. FERNOW. The data required for the tabulation of the details of consumption were obtained from a canvass made this year, and the report states that the returns cover about 60% of the total mileage of this country. Using the reported number as a basis and assuming that the unreported mileage consumes a proportionate number, the table shows that 60,000,000 ties are needed annually for repairs on the railroads of this country. It is stated that 13,000,000 ties are used annually for new construction, making the total annual consumption 73,000,000 ties, while a foot note states that 80,000,000 ties per annum for renewals is nearer the truth than the first named figures.

A summary of the table showing consumption of forest supplies by railroads is given below:

TABLE I.—CONSUMPTION OF FOREST SUPPLIES BY RAILWAYS—SUMMARY FOR THE WHOLE COUNTRY.

Number.	Districts.	Miles of track.	Miles reported.	Per cent. of total track reported.	Ties per mile in track.	Ties used annually for renewal by reporting roads. 1 = 1,000	Proportionate number used by all roads. 1 = 1,000	Ties per mile for renewal.	Kinds of timber used. Per cent.	Average prices.	Bridge and other lumber used annually by roads reporting.	Average amount of lumber per mile used annually by roads reporting.	Proportionate amount of lumber used by all roads.
											M. ft. B. M.	Ft. B. M.	M. ft. B. M.
1.	New England group	10,813	6,506	60.2	2,752	2,373	3,942	365	Chestnut..52 Oak..... 6 Cedar. ....26 Various...16	36-55 36-55 33 35-47	24,499	3,766	40,722
2.	Middle Atlantic group	31,281	23,135	73.9	2,728	7,068	9,543	305	Oak .....73 Chestnut.. 8 Pine .....11 Cedar.. 5 Various... 3	49-70 25-60 46-64 35-53	*64,613	4,449	100,899
3.	South Atlantic group	16,224	6,256	38.6	2,726	2,471	6,402	395	Oak.....43 Pine .....50 Cypress.... 7	25-33 20-25 27-28	27,593	4,411	71,564
4.	Northern Central group	56,032	33,519	60.1	2,916	9,150	15,224	272	Oak .....78 Cedar.....11 Tamarack 3 Hemlock.. 5 Various... 3	25-55 15 40 15-18 15-18	130,392	4,092	229,283
5.	Gulf and Mississippi group	12,522	5,558	44 4	2,770	2,026	4,564	365	Oak .....68 Pine 32	25-29 20-25	9,300	3,167	39,657
6.	Northwestern group	20,744	16,961	81.8	2,759	5,412	6,031	319	Oak.....40 Elm..... 4 Pine .....26 Various .30	31-60 18-39 16-33	46,242	2,863	59,390
7.	Southwestern and Pacific group	43,881	29,520	46.8	2,310	6,378	3,753	311	Redwood .15 Cedar. .... 7 Fir..... 5 Pine .....15 Oak.....54 Cypress... 4	30-53 22-38 22-38 25-34 26-75	53,618	3,188	139,893
	Totals	191,497	112,455	58.8	2,694	34,878	30,035	310			356,259	3,748	681,408

* Returns from the Pennsylvania R. R. and from the eastern division of the Baltimore & Ohio included no report as to the amount of lumber used, and the above estimate is made without reference to those roads, which include 8,602 miles of track, or more than one-third of the whole mileage of the group. These roads use iron, brick and stone for bridges and buildings more largely than other roads, but it would probably be fair to add 25 per cent. to the above estimate on their account

As to the duration of timber, the report states that no comparative tests have ever been made, and that the experiences of practice give only conditional results which are in consequence not strictly comparable. Attention is called to the fact that the color of the heart wood of different species may be made a criterion as to the durability of timber, and a table is presented showing that those woods having the darkest heart are generally most durable. The explanation of this is that the coloration of the heart wood is due to the presence of tannin, which acts as an antiseptic by making the albuminates insoluble.

This table is given below, and in general bears out the truth of the statement: "If we denote by *v. d.* 'very durable,' *d.* 'durable,' and *n.* 'not durable' timbers, we find:"

Pronounced black, brown, or red heart.	Gray, light, brown, light red, yellow heart.	White or slightly colored heart.
Lignumvitæ *v. d.*	Cucumber tree *n.d.*	Beech *n.*
Mesquit *d. d.*	Tulip tree *n.*	Birch *n.*
Catalpa *v. d.*	Black locust *v. d.*	Gum *n.*
Osage Orange *v. d.*	Coffee tree *d.*	Maple *n.*
Mulberry *v. d.*	Honey locust *d.*	Linden *n.*
Black walnut *v. d.*	Sassafras *d.*	Hemlock *n.*
California Cedar *v. d.*	Elm *d.*	Spruce *n.*
Red Cedar *v. d.*	Oak *d.*	Fir *n.*
Bald Cypress *v. d.*	Willow *n.*	Torreya *v. d.*
Redwood *v. d.*	Pine *d.*	Lawson's Cypress *v. d.*
Tamarack *v. d.*	White cedar *v. d.*	Port Orford Cedar *v. d*
Douglas fir	Cypress (California) *v.d.*	

A table showing the comparative life in years of wooden ties of various kinds; but as there is so much that is dubious about this we do not reproduce it. California Redwood is the most durable, lasting about 50 per cent. longer than white oak, or 11 to 12 years.

The durability of the various kinds of wooden ties under different conditions of use as regards ballast, weight of rolling stock, climate, condition of timber when felled, method of preparation, whether by sawing or hewing, age of timber, time and method of seasoning and cost and results of preservative methods are discussed in detail, but it is almost impossible to present extracts of this portion of the report without taking up more space than is allowable, besides which, the testimony of different railroads as to the durability of ties of similar material is necessarily conflicting, as each case presents different conditions, and should be studied by itself for any one locality.

The subject of metal tie plates is also taken up in the first part of the report, and the obvious objects which such plates have to serve are laid down in the five following propositions:

(1) A more even distribution of rail pressure over a greater area of the tie, and thereby

(2) Retardation of the mechanical destruction of the tie by cutting, and

(3) Less danger of tilting of rails;

(4) To prevent the lateral bending of spikes or screws and thereby loosening of rail;

(5) To increase resistance of screws and spikes against lateral motion or spreading of rails.

The report further states that to attain these objects the following conditions in the form of the plate are necessary:

(1) It should be sufficiently large to increase sensibly the bearing surface upon the tie. A length of 5½ ins. and a width of 4½ ins. in addition to the width of the rail-foot or altogether 8½ to 9 ins. are considered minimum dimensions.

(2) It should be sufficiently thick to take up all pressures without effect on the shape of the plate; the minimum thickness is given as ⅛ in.

(3) It should be so placed that the larger bearing surface be on the inside of the rail where the pressure is greatest and resistance therefore most needed, so that 2½ ins., lie inside and 2 ins. outside the rails.

(4) It should increase the resistance of spikes or bolts against lateral pressure, by projecting shoulders against which the fastenings bear.

(5) It should relieve the fastenings from lateral pressures by having the rail-foot rest directly against projecting shoulders.

(6) It should be secured against lateral motion upon the ties by having the lower surface provided with short sharp ridges (not deeper than 3-16 to ¼ in., three being used, the inner tooth rim deeper that the outer), or other contrivances which increase the friction between plate and wood.

The report gives the experience of several American roads with a tie-plate of channel form 8 ins. long, 3⅛ ins. wide 3-16 in. thick, having flanges turned down on the long sides, ⅝ ins. deep, these flanges being driven into the tie parallel with the fiber. Three roads report very satisfactory results with these, but two roads think them too light.

This part of the report ends by calling attention to the

proper method of computing the financial value of different kinds of ties, varying in first cost, durability and cost of maintenance. A table is prepared showing the annual charge for ties of various first cost, and having terms of life varying from 4 to 30 years. The table given is computed for an interest rate of 5% per annum, compounded annually. In order that a tie of longer life may be properly compared with one of short life, another table is given for computing the annual charge of renewals. We regret that we have not room for these useful tables.

Part I. of the report by Mr. TRATMAN treats of the use of metal ties on railways in foreign countries and in the United States. This part of the report gives in detail the experience and practice of more than a hundred railroads in the use of metal ties, all of the principal forms being clearly shown on accompanying plates. Many forms of metal ties are shown and discussed, and it is manifestly impossible to even enumerate them here, but it may be generally stated that the form thus far found to be suitable is a cross tie of inverted trough section closed at the ends, narrowed and deepened in the middle and re-enforced at the rail seats.

The following, Table 2, shows the proportions of the several general forms in use in different countries and the footnote shows the present tendency to the use of cross ties:

TABLE 2.—SUMMARY OF METAL TIES OF ALL KINDS IN USE.

Section.	Longitudinals. Miles.	Bowls and plates. Miles.	Cross-ties. Miles.	Total metal track. Miles.
Europe	3,637	252	6,240	10,222
Africa	....	994	297	1,291
Australasia	....	....	186	186
Asia	....	5,312	4,002	9,314
So. and Central America and Mexico	....	3,456	332	3,788
North America	....	....	2	2
Total	3,637	10,014	11,059	24,803

NOTE.—The use of longitudinals is being abandoned. The bowls and plates are mainly in service in hot countries, with special conditions of traffic, as in India and South America. The cross-ties are used under conditions of climate, traffic, etc., most nearly according to the conditions obtaining in this country.

The cross section of nearly all the cross-ties employed to any extent is derived from the type invented by the French engineer VAUTHERIN, the first trials of which were made about 25 years ago on the Paris, Lyons & Mediterranean Ry. This type has a flat top table, inclined sides flaring outward from the top, and with narrow horizontal flanges on the bottom edges, it forms with closed ends an inverted trough filled with ballast.

The lower horizontal flanges have been found objectionable with stone or similar ballast, and in consequence in the later forms the horizontal flange has been replaced by a rib of triangular section, offering less resistance to the proper settlement of the tie in the ballast.

The earlier forms had parallel sides, but these, in many cases, have been replaced by ties of similar section at the rail seats, but narrowed in the middle to give a better hold on the ballast and thus prevent lateral shifting. Economy of material is also gained in the later forms by making them of varying thickness, this being the greatest under the rail seat and at the bolt holes.

As to the proper weight for a cross tie, the report shows that different roads of standard gauge use, with success on main lines, cross ties of weights varying from 110 to 174 lbs., the former being used on the Netherlands State Railways, and the latter on the London & Northwestern.

From a study of the Continental practice, Mr. TRATMAN concludes that the standard weight of a cross tie might be between 110 and 132 lbs., but says that the latter figure might be exceeded in exceptional cases. This, we fear is quite too hopeful an estimate for American practice. We see nothing as yet to warrant the conclusion that less than 150 lb. ties will ever succeed here.

As to method of manufacture, cross ties of trough section are either rolled to shape, stamped from a flat plate, or a combination of rolling and stamping is used to produce those with closed ends. Some of the forms are made of varying thickness in the process of rolling.

Many methods of fastening flange rails to the ties are shown, a few of the principal forms being as follows:

A good fastening is used in Belgium, India and Mexico, consisting of a taper key driven horizontally between the rail flange and a projecting clip, which is formed by punching up the material of the tie, or on a clip riveted to the top of the tie. This key is curved in cross section, the concave side fitting over the outer edge of the rail flange, the convex side fitting under the clips on the top of the tie. The end of the key is split so that it can be expanded after driving. The side of the rail opposite the key is held by a lug or clip. This fastening when well proportioned is shown to have given good results.

Another form of fastening which has been proved good in use, consists of a T-head bolt passing through the top of the tie, the slots for their introduction having their longer axes at right angles to the axis of the rail.

With these bolts various forms of clamp plates are used, one of which consists of a short piece of angle iron with unequal legs, the bottom of the short leg resting on the top of the tie, while the end of the longer leg takes a bearing near the outer edge of the rail flange, a short space being left between the bolt and the outer edge of the rail flange to allow a slight lateral adjustment for gauge.

Another good form of clamp plate is so constructed that a portion of it fills that part of the slot in the top of the tie which is not occupied by the bolt. This form relieves the bolt of lateral pressure. With some of these bolt and clamp fastenings a nut-lock is used.

It is specially noted that many devices have been used to avoid direct contact between the base of rail and tie, as such contact was supposed to lessen the elasticity of the road bed and cause undue shock and wear of both rolling stock and permanent way. The report states, however, that where good fastenings are used, holding the parts firmly together, no such devices are needed, and that the elasticity is sufficient without them.

Experience has proved that metal ties of trough section having parallel sides and open ends work laterally in the track. To obviate this difficulty the later forms have been made with closed ends, thus presenting a resisting surface, and this is shown to have had the effect of preventing lateral movement.

In several places in the report it is stated that metal ties where laid in earth or poorly drained ballast, become loose through a pumping action under the movement of trains, but as this is also true to a certain extent with wooden ties under similar conditions, metal ties need not suffer by the comparison in this respect.

In regard to cost of maintenance of track on metal ties, it is shown that as compared with wood the cost is greater for the first three or four years, after which this cost reduces rapidly, and several cases are cited showing the average cost of maintenance to be about three-fourths of that with wooden ties. With metal track the usual practice is to use wooden ties at frogs and switches, but in Germany and Switzerland metal ties are used at these points with success.

Various terms of life of metal ties are shown in the different reports, and a fair estimate based on the different showings seems to point to a life of at least 30 years for a well-proportioned metal tie laid in good ballast. Contrary to expectations it is found that in main lines the amount of oxidation in good ballast is very little, and has but a small effect on the life. Where metal ties are laid in slag containing sulphur, or in damp tunnels, the corrosion is noticeable of course.

The conclusions deduced by the compiler from the detailed reports of metal track, are all favorable to it as regards its value and ultimate economy, although the most forcible logic, that of figures, might have been given in more detail.

Published with the report is a descriptive index of United States patents relating to metal railway track, from July, 1839, to March, 1890. This list contains 491 patents, and shows that most of these have been issued during the last ten years.

TRADE PUBLICATIONS.

—*Reference Book of the Norfolk & Western R. R. Co.*, Outlining the Present Condition of Progress in Mining, Manufactures and Agriculture, and the Undeveloped Resources of those portions of the State of Virginia traversed by it. 12mo. Pamph., pp. 94.

This pamphlet does very cleverly and well what its title indicates. It is freely illustrated and preceded by an ingenious map.

—*Catalogue of the Cook Well Co.*, St. Louis, Mo. Pamph., pp. 60.

Almost all kinds of plant connected with the sinking and working of artesian and tubular wells are illustrated in this pamphlet, the specialty of the company being a system of tubular deep wells combined in gangs for town supply. As our readers know, great numbers of towns are very successfully supplied in this way.

—*Catalogue of Improved Steam Pumps and Hydraulic Machinery.* M. T. Davidson, Brooklyn, N. Y. Pamph., 12mo, pp. 88.

Besides the standard machinery described in this catalogue, we note an independent air pump and condenser for use with non-condensing engines, and a triple expansion-pumping engine built for the pumping station of the Brooklyn water-works at Jamaica, Long Island. About a dozen pages of mathematical, steam and hydraulic tables are given.

SOCIETY PROCEEDINGS.

Engineers' Club of Cincinnati.—At the meeting in July a committee was appointed to consider the proposition that the club become a member of the Association of Engineering Societies. The following question was presented and discussed by Messrs. Nicholson, Whinery, Ruggles, and Schenk: "In a city of 300,000 inhabitants, what is the smallest quantity of water per capita per day necessary for the necessities and comforts of its citizens, provided there is neither waste nor unnecessary use of the water?" Mr. Ruggles, as the essayist for the evening, read a historical sketch of the Ohio & Mississippi Ry. Dr. P. H. Dudley, of New York, who was present—having recently returned from an inspection trip with his dynagraph car over the roads of the Queen & Crescent system—entertained the meeting with a description of his apparatus, and exhibited some diagrams of the work performed by it.

At the August meeting the committee appointed to ascertain the advantage to the club to be gained by its joining the Association of American Engineering Societies, presented a partial report. The question: "What would be the effect in the case of a Howe truss bridge that had given indications of failure of putting in a support of piles or similar temporary bents midway of the span? What would be the effect if it were a combination bridge or Warren girder?" was discussed by Messrs. Merrill, Stuart and Nicholson. Papers on the following subjects were read: "Cement Tests," by Phil. J. Schopp; "Some Ideas about River Engineering," by Oswald Dietz. The latter comprised a suggestion for the establishment of a school for experimental hydraulic engineering.

International Congress on Inland Navigation—Annual Convention.—The fourth annual convention of the congress was held in Manchester, England, July 28 to Aug. 1. The majority of the papers presented few novelties in the line of inland navigation to those acquainted with the subject. We can abstract a few of them only.

The President, Sir MICHAEL HICKS-BEACH, was somewhat ashamed to state that the canals and rivers of the United Kingdom were apparently a matter of little concern to Her Majesty's government, since it had collected but few statistics of inland navigation. From the figures at his disposal, it seemed probable that there were approximately 3,813 miles of navigable water in the kingdom, which was used last year in handling 36,300,000 tons of freight. On each mile between 9,000 and 10,000 tons were carried, as compared with 14,000 tons per mile on the railways. Of the paid-up capital invested in these canals, 25% paid a 2 to 3% dividend, 47% paid a 3 to 4% dividend, and 9% paid a 4 to 10½% dividend; 81% of the whole number paid more than 2% to the holders, and only 6% of the capital paid no dividend. Out of the whole mileage in the United Kingdom, a third belongs to the railway companies; this third, however, carries only a fourth of the total tonnage. The gross receipts per mile, moreover, were considerably less than they were on independent canals. From these facts, he argued that the canals are best managed as independent carriers, entirely separate from the railways or the government. The Manchester Ship Canal was entirely due to individual enterprise. A Chancellor of the Exchequer would certainly have hesitated before placing the money of the taxpayers in a commercial enterprise of so great and novel a character, practically nothing less than the building of a double line of docks, 35 miles long, which must certainly change the methods of trading in a great district.

The members of the Congress were separated for expediting business into four sections: Section A discussed canals and canalized rivers, Section B was occupied with ship canals and tidal rivers, Section C was devoted to statistical matters, and Section D examined the financial and economical sides of the subject.

One excellent idea of the managing officers was the printing in several languages of the majority of the papers to be presented and the distribution of the copies some time in advance. These papers were usually considered as read, and the whole time of the congress thus devoted to discussion.

The first paper presented in Section A was by Mr. J. A. SAXER on the River Weaver Navigation. He stated that the improvements in this river, which flows from the southwest corner of Cheshire northward into the Mersey, were begun in 1721 by increasing the depth of the river to 4.5 ft. for some 15 miles. From that time on other improvements were made until now there are 20 miles of 9·5 to 10·5 ft. channel controlled by the company. Up to 1840, the barges were hauled by men alone; horses were then put in the service, and in 1862 steam flats were introduced. At present the entire traffic is handled by these steam flats, which also carry a cargo. The charge for men was one $1 per day, 4 men being required for each barge; horses were furnished for $2 a day. A tow consisting of a flat and three barges costs 26 cts. a mile in the trip from Liverpool to Winsford.

In 1840, the tonnage of a barge never exceeded 100 tons; now it runs as high as 390 tons. The last built locks are 220 × 42 × 15 ft. and can lift 1,000 tons in 15 minutes. The width of the channel averages 90 ft. at the water level and 45 to 50 ft. at the bed. The most noticeable engineering feature of the canal is Anderton's lift for transferring barges from the Weaver to the canals of the Staffordshire potteries. This lift consists of two tanks 75 × 15 × 5 ft. of water capacity; each tank weighs about 250 tons and is supported by a single ram 3 ft. in diameter. The tanks rise and fall alternately, the descending trough being loaded with an additional depth of 6 ins. of water in order to lift the other. The total height of lift is 50 ft. 1 in., and the operation requires from 15 to 20 minutes. The greatest allowable weight is 100 tons. This lift, opened in 1875, was the forerunner of the larger and more powerful ones at Les Fontinettes in France and La Louvière in Belgium. As might be expected on a canal allowing steam towing the cost of maintenance is large. The best protection for the banks consists of a row of short stakes driven 2 ft.

into the mud and a surface of coarse rubble on these, the stone-work rising 2.5 ft. above the water.

Mr. W. H. Bartholomew, engineer of the Aire and Calder Navigation, contributed a paper with regard to that undertaking, which was described as partly a river and partly a canal waterway. The first act of Parliament with reference to the two rivers was passed in 1607. The proprietors were now navigators of a total length of 95½ miles. The Bradford canal was almost unique in its character, from the fact that pumping engines were provided at each lock, and that as the locks were emptied the water was pumped back again to the higher level, thus avoiding any loss from the passage of the traffic. One special feature in the traffic on the Aire and Calder Navigation was that of the conveyance, by what were termed "compartments," of minerals, mainly coal. These compartment boats were constructed of steel, and

Bartholomew's System, Aire & Calder Canal.

were 16 ft. × 20 ft. × 8 ft. deep, and carried 35 tons each. Each of these barges was provided with buffers, and the whole were attached together like railway wagons. A wire rope on each side connected with the tug, and enabled the crew of the latter to steer them. Thus no crews were required on the "comparments," and a greasaving in transit was thereby effected. At Goole were two hydraulic hoists, and here the train was broken up and the "compartment" boats lifted singly out of the water in a "cage" provided for the purpose, and the contents tipped into the seagoing vessel. The compartments could be covered over and used for the conveyance of damageable traffic when required. They traveled in trains varying from ten to thirty at a time, but 700 tons was regarded as a very convenient train.

M. E. De Hoerschelmann, in a paper on "The Reorganization of the Marie Fluvial System (canal from the Volga to the Neva)," stated that Russia possessed the most extended waterways of any country, the most important of which was the Volga and the Marie canal system, connecting that river with St. Petersburg and with the Baltic. Notwithstanding the construction recently of several railways, connecting the fertile parts of the country situated along the Volga with the ports on the Baltic, the traffic on the Marie system was continually increasing. During the last 30 years the quantity of goods annually carried by this waterway from the Volga to the Baltic has been more than doubled. In 1858 it was about 490,000 tons; at the present moment it was 1,100,000 tons, mostly grain, which was carried by 3,400 boats, each holding 328 tons. The government had acceeded to plans which had been projected with the object of making the Marie system available for boats 210 ft. long, 31.5 ft. wide, and drawing 5.9 ft. Barges of a length of 210 ft. generally navigated the Volga drawing about 7.6 ft. and carrying 983 tons. On their arrival at Rybinsk, these barges could transfer to other boats one-third of their cargo and continue their voyage through the Marie system with a cargo of 655 tons and drawing 5.9 ft. By this means two-thirds of the goods, transported could go from the Volga to St. Petersburg without breaking bulk. In future, therefore, only one-third would require transhipment. The total length of the system was 2,507 miles; it highest point was situated at an altitude of 420 ft. above sea level. After the reorganization of the Marie system was completed there would only be between the Caspian Sea and the Baltic 37 locks, with falls not exceeding 10.5 ft. The minimum depth of water would be 3.5 ft. Thus there would be one lock for 67.757 miles of waterway.

Mr. W. H. Bailey, ex-President of the Manchester Association of Engineers, presented a paper on "Canal Boat Propulsion, Past and Present." He stated that the first application of steam for canal boat propulsion was made by the Duke of Bridgewater, and Fulton, the American inventor, in the year 1799. He could not find an account in any published history of the steamboat, or in any account of Fulton, of his having been in this neighborhood at that time, but it is stated that in 1803 he was experimenting with a paddle-wheel boat on the Seine, and in 1807 his boat, the *Claremont*, which had paddle wheels on each side, was at work on the Hudson, in America. He thought there was no doubt that the Duke of Bridgewater employed Fulton to construct an inclined plane for the underground canal at Walkden, near Manchester, which enabled boats full of coal to descend to a lower level canal by means of a windlass and ropes; their weight caused the empty return boats to be drawn up to the canal on a higher level, the weight of coal on its way to Manchester (not its heat) being the motive power of this system. The Rev. Mr. Egerton, in the year 1800, claimed this system as having been invented by the Duke of Bridgewater himself, but he was probably mistaken. This work was done in 1794, and it was about this time that Fulton suggested the feasibility of propelling boats on the canal by steam power. In 1799 a steamboat, which was named the *Bonaparte*, was completed and set to work on the Bridgewater Canal, but on its first voyage the chimney was found too high for the bridges, and was hinged so that it could be lowered at will. We are told that it took a large number of 10-ton coal boats to Manchester, but not so quickly as horses. It was found that the swash considerably injured the canal banks, and experiments were then made with paddle-wheels of different shapes, and also with reciprocating duck foot paddles. After many experiments, it was decided to return to the old method of hauling the boats by men or mules, and as shortly after the trial there was a breakdown of the aqueduct, carrying the canal over the river Mersey at Stretford, the engine was taken out and fixed there for pumping the water out of the foundations during the progress of repairs, and in doing this, as is stated, it soon compensated for the outlay in experimenting with the steamboat.

In the year 1831, Mr. William Fairbairn directed his attention to the use of steam for propelling canal and river boats, and although labor and horses and men at that time could be had at least 30 per cent. cheaper than similar labor now, he advocated the use of steam, and demonstrated its great economy, especially for boats on those canals and rivers which have a free outlet to the sea, because, to use his words, "such vessels would be also able to extend their voyage to distant parts." In a pamphlet published by him in the year 1831, on the use of steam as a moving power on canals, he gives the results of various experiments, conclusively showing that steamboats designed by him did the work at fully half the cost of similar work done by horses and men under the old system. His concluding words, written 55 years ago, are full of prophetic interest to us at the present moment: "In my opinion the field for improvement in canal and river steam navigation appears to be most extensive, and if pursued with proper attention to the disposition of the material so as to obtain the greatest possible results, no one can limit the great amount of improvement that can thus be obtained in a few years."

From the year 1855 several attempts have been made on the Leeds & Liverpool Canal to introduce steam towage, and in 1879 the company tried a screw steamer, with compound condensing engines, to tow six 40-ton barges on a river or deep canal; this was a tug boat and carried no cargo. It was very quickly discovered that it was next to useless on a shallow canal—the section of that particular waterway only averages from 40 to 50 ft. in width at the surface, with flat sloping sides under water, tapering down to a mid-channel or gutter with an average depth of only 4½ ft.—inasmuch as with that depth (in mid-channel only) a screw propeller of sufficient diameter could not be used to utilize the power of the engines without a very great amount of "slip" and churning of the water instead of doing useful work; it was also found that when the least obstruction took place by meeting other barges near bridges, or sharp curves, causing the slowing up or stoppage entirely of the tug the barges in tow would (to use the words of my informant) insist on running pell-mell into one another, for the simple reason that they could not apply a brake, and further, they used to get zig-zagged across the canal in every direction, which often caused a delay of 15 to 20 minutes before all could be got under way again. Another attempt has since been made which utilized the power of the engines with more success. Two narrow boats of about 5 ft. beam were braced side by side under one deck, with a longitudinal space of about 3 ft. between each, and in this space was one paddle-wheel, with a long-stroke horizontal engine on deck over each boat driving a crank on each end of the paddle shaft, set at right angles. Across the deck stood a locomotive boiler, each boat carrying its own proportion of the weight of the boiler; the funnel had to be placed at an angle of 45°, so as to get under the very low bridges. This steamer towed fairly well 5 barges of coal, but caused a great wash in the canal, to the manifest injury of the banks, and was subject to the steering difficulties whenever any obstructions were met, which in this canal are frequent, owing to its very tortuous character, some idea of which may be formed when it is stated that although the distance between Liverpool and Wigan is only 19 miles by railway, it is no less than 34 miles by canal, and while between Liverpool and Leeds by rail is 80 miles, it is 128 miles by canal. In towing a train of 5 or 6 barges there was enormous delay in getting through the locks, of which there are no fewer than 93 between Liverpool and Leeds. Mr. W. Wilkinson, having given considerable attention to these difficulties, suggested the utilizing of the ordinary barges as tugs by putting in small engines, just of sufficient power to drive a screw propeller as large as could be made available without a large percentage of positive "slip," and further to make each tug carry a paying cargo. In conjunction with Mr. Charles White, the company's engineer, Mr. Wilkinson fitted up one of the barges with engines. When tried it was found that it would tow 2 others very well at 2 miles an hour, and in some parts of the canal where the depth is a little greater the speed would rise to 2½ and 2¾ miles an hour; under similar conditions, with only one barge in tow, as high as 3¼ to 3½ miles an hour, but at the latter speed the displacement sets up a rolling wave along both banks, which does injury, whereas at 2 and 2½ miles an hour there is no perceptible disturbance of the water at the sides, and only a very slight disturbance in the center, which is beneficial, as it keeps the mid-channel well dredged and maintains a good waterway. The successful working of the first steamer was so great that, since that time, Mr. Wilkinson's firm have fitted some 15 or 16 more for the same canal, in addition to one for towing through Foulbridge tunnel, one mile in length. This tug has both ends alike, with 2 propellers, one at the bow and one at the stern; likewise a rudder at bow and stern, so that the boat does not require to be turned about at each journey. Prior to the adoption of this tug all barges had to be worked through the tunnel by the men, who lay on their sides on the gunwale of the boat, pushing it along with their feet against the tunnel wall, and taking 2 to 2½ hours to travel the mile, whereas the tug tows 2 and 3 loaded barges at a time the same distance (one mile) in 20 to 25 minutes, the only hands required being the engineer and helmsman. The engine and boiler are placed as far aft as possible. The form of propeller is the result of very exhaustive and costly series of experiments; with full-sized ones in actual work it gives the best results in shallow waters. It would not, however, be well adapted for deep water towage. The helmsman can perform the following duties without leaving his helm, viz., start, stop, or reverse the engines, lower the funnel at bridges, blow the whistle, and use the auxiliary steam jet for funnel; he can also observe the condition of his boiler, for he has the water gauge and steam gauge in full view before him. As to the carriage rates charged by the Leeds & Liverpool Co., they vary from 1 to 4 cts. per ton-mile, the lower rate being for minerals, coal, etc., and the higher for manufactured goods. The steamers have conduced much to the punctuality and regularity of working on the canal. When compared with horse towage, they have accelerated the speed some 40 per cent.

Mr. Bartholomew, of the Aire and Calder Navigation, has introduced a system of steamboat trains of a very successful character. (See above.) A steam tug propels a train of boats, about 10 or 12 in number, each carrying about 40 tons. The boats are 20 ft. long, 16 ft. wide and 7 ft. 6 ins. deep, the steam "pusher" with the steerer being behind. The advantage in having a tug (*i*) behind this train of boats consists in the great control of the steaming power. The boats are threaded together by means of wire rope controlled by 2 cylinders which are self-acting, and are under the charge of the man who is steering. By lengthening and shortening the wire ropes on each side of the train, it can be guided to go in any curve, the train being left to rise and fall vertically according to any little variation of head line; it is not bound rigidly in any way. Buffers are attached to the ends of the boats, which have a tendency to bring back again into line in case of any slight disorganization caused by wind or water, the full control of the train, and its direction is under the guidance of the steerer. The system is a train of wagons on water without wheels, and one excellent feature in the arrangement will be appreciated when it is stated that when the boat train arrives at Goole, there is a large hydraulic lift which receives each wagon after being caged. After being secured, it turns over and discharges its cargo into the ship, and in lowering the empty wagon half the water of the lift is forced back into the accumulator. The cost of haulage by this system, at 4½ to 6 miles an hour, is, for general merchandise, 1-17 of a cent per ton-mile, but for minerals only 1-59 of a cent per ton-mile, and this includes taking the empty barges back. There is a system on the Rhine by which a steel wire rope is used. Mr. Leader Williams conducted experiments on the use of the wire rope system on the Bridgewater Canal some years ago. Its economy was well demonstrated; but where there are bends and turns in a canal and other traffic, not only in the same direction, but also in the opposite direction, the wire rope system on a narrow canal was found to be practically unworkable.

Most of the canals of this country are 100 years old (the Bridgewater Canal having been commenced in 1759, the Ashton Canal in 1792, the Derby Canal in 1795, Droitwich Canal in 1768, the Grand Junction Canal 1793). The number of locks, the narrowness of the canals, and imperfect condition of the banks, and also the great bulk of the early low-pressure engines and boilers were among the early retarding influences which prevented the use of steam. Mr. Bailey had much difficulty in obtaining reports from those in charge of canals as to the methods now in use. Steam, however, is now employed generally all over the country for haulage, and in examining evidence given before the Committee of the House of Commons, the economy of steam was fully admitted. Mr. Lloyd, engineer and general manager of the Warwick canals, in his evidence, said there was no doubt that if the present old canals were deepened and widened, the use of steam power would be far more general.

Dr. M. Levy stated that on the canals of St. Maurice and St. Maur, which are operated by the French Government, a speed of 1.56 to 1.75 miles an hour is maintained by cable towing, and less trouble is experienced in locking than by any other method. Unless the total tonnage however, is very large, the system is the most expensive in use. (See Engineering News, June 14, 1890.)

[*To be continued.*]

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AND

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COMING TECHNICAL MEETINGS.

New York Railway Club.—Next meeting, Sept. 18. Rooms, 118 Liberty St.

Engineers' Club of Cincinnati.—Next meeting, Sept. 18. Secy., J. F. Wilson.

Civil Engineers' Society of St. Paul.—Next meeting, Sept. 1. Secy., G. L. Wilson.

Western Society of Engineers.—Next meeting, Sept. 2. Secy., J. W. Weston, 230 La Salle St., Chicago.

American Society of Civil Engineers.—Next meeting, Sept. 3. Secy., John Bogart, 127 E. 23d St., New York.

Boston Society of Engineers.—Next meeting, Sept. 3. Rooms, 67 Washington Street.

Association of Civil Engineers of Dallas.—Next meeting, Sept. 5. Secy., E. K. Smoot, Elm and Austin Sts.

Engineers' Club of Philadelphia.—Next meeting, Sept. 6. Secy., Howard Murphy, 1122 Girard St.

Civil Engineers' Club of Cleveland.—Next meeting, Sept. 9. Secy., C. O. Palmer, 22 Cedar Ave.

Civil Engineers' Association of Kansas.—Next meeting, Sept. 10. Secy., J. C. Herring, Wichita, Kan.

Engineering Association of the Southwest.—Next meeting, Sept. 11. Secy., Olin H. Landreth, Vanderbilt University, Nashville, Tenn.

Western Railway Club.—Next meeting, Sept. 16. Rooms, Phenix Building, Chicago.

Engineers' Society of Western Pennsylvania.—Next meeting, Sept. 16. Secy., S. M. Wickersham, Pittsburg, Pa.

Engineers' Club of St. Louis.—Next meeting, Sept. 17. Secy., W. H. Bryan, 30 South 7th St.

Boston Society of Civil Engineers.—Next meeting, Sept. 17. Secy., S. E. Tinkham.

American Society of Railway Superintendents.—Annual meeting at New York on the day preceding the fall meeting of the General Time Convention. Secy., C. A. Hammond, 350 Atlantic Ave., Boston, Mass.

Roadmasters' Association of America.—Eighth annual meeting at Detroit, Mich., beginning Sept. 9.

THE United States has now become the largest iron-producing country in the world, unless there should be a very great change during the next six months, as is made clear by the Census Bulletin No. 9, abstracted in another column, having passed Great Britain handsomely, not only as respects its present output but its largest output on record, which was away back in 1882. The comparative figures of output since 1882, as issued early in the year by the American Iron & Steel Association (ENGINEERING NEWS, Feb. 1, 1890), supplemented by the later figures now available, stand as follows:

PIG IRON OUTPUT IN GROSS TONS.

Years.	Great Britain.	United States.
1882	8,586,680	4,623,323
1883	8,529,300	4,595,510
1884	7,811,727	4,097,868
1885	7,415,469	4,044,526
1886	7,009,754	5,683,329
1887	7,559,518	6,417,148
1888	7,998,969	6,489,738
1889	8,322,824	7,604,525
1890 1st half		4,615,837
1890 2d half		est. 4,700,000
Total actual and estimated 1890		9,315,837
Actual output year ending June 30, 1890		8,557,876

The production of the last half of 1890 seems quite certain to reach and exceed the moderate quantity estimated, there being no signs of any check in the demand for iron, but rather to further increase, so that the output of the calendar year 1890 seems reasonably certain to reach the enormous aggregate of at least 9,500,000 gross tons, or 10,640,000 net tons. In evidence of this, the half-yearly output of the United States, for the last three half years, has been as follows:

	Net tons.	Gross tons.
First half 1889	4,100,995	3,662,486
Last half 1889	4,415,084	3,942,039
First half 1890	5,169,737	4,615,837

The August production, so far as reported, is at the rate of over 9,500,000 gross tons per year, and is considered likely to gradually increase until the end of the year, while it seems most unlikely that there will be any serious check in production this year. On the other hand, the British output also is in a healthy condition, but the demand is rather less this year than last, and it is not considered likely to exceed that for 1882, even if it reaches it. If we may judge of the future by the past, it is more than likely that the end of this century will see the United States with twice the annual iron output of Great Britain. The amazing advance which both countries have made since 1830 is shown in the following little table:

	Thousands of Gross Tons					
	1830.	1850.	1870.	1882.	1888.	1890.
Great Britain	682	2,250	5,230	8,488	8,322	8,500±
United States	165	560	1,580	4,023	7,605	9,500±
Per cent. U. S. to Great Brit.	24.2	24.8	30.2	47.2	91.4	111.8±

ALMOST as we go to press two further Census Bulletins, Nos. 10 and 11, reach us, the first one devoted to the quicksilver mining industry, the other to street railway statistics. The quicksilver record is a notable exception to almost all others, in showing a decrease in the past decade, both in American and in total quicksilver production. The record stands as follows:

	Yearly output. U. S.	Yearly output. Foreign.	Flasks. Total.
1880	59,926	59,242	119,168
1889	26,464	74,772	101,236

The explanation is simple: there has been a decrease in demand. The average price of quicksilver per flask of 76½ lbs. was, in the decade 1850–59, $56.45; 1860–69, $44.00; 1870–79, $49.53; 1880–89, $33.07. Of late years, however, the price has been increasing, having risen from $30.25 in 1885 to $45 in 1889, but as yet the production has not responded. The quicksilver industry, as also (by a strange omission) the street railway system, has never before been the subject of census investigation, so that exact official comparisons with 1880 are impossible; but, with an amount of good judgment which is not always displayed in compiling such public records, the best unofficial records are availed of to make the census statistics as valuable as possible. This, and the promptness with which returns are being published, give reasonable ground for hope that the 1890 census is to be unusually good and complete.

THE street railway statistics extend only to Dec. 31, 1889, the effort to gather them up to June 30, 1890, having been apparently judged impossible. There were at that time 476 cities and towns enjoying so-called "rapid transit" street railways from 807 different companies. The census bulletin covers only the 286 street railways which supply the 56 principal cities, leaving 521 companies operating in 420 different cities and towns as yet unreported. In these 56 cities there were in 1889, 3,151 miles of line, divided as follows:

Miles single track	1,580
Miles double track (49.858)	1,570½
Miles sidings	150
Miles track	4,871

In 1880 there were 1,690 miles of line in the same cities, an increase of 86.50 per cent. Since 1886 the increase has been about 11 per cent. annually, before that, about 6 per cent.

It will thus be seen that street railway mileage is increasing at a much greater rate than the city population, and when the traffic statistics are available (which is not yet) they will know that the use of street railways has multiplied in vastly greater ratio. The increase of general railway mileage between 1880 and 1889 was 73 per cent. But the most significant part of the record is the table which we reproduce in full in another column, showing the extent to which electric, cable, elevated and steam surface roads are used in place of animal power. It is practically within this decade only that street railway traffic has differentiated itself into these different modes of transportation, and there can be little doubt that the change of this decade, great as it is, marks only the beginning of a great change to go on in the next decade. On Jan. 1, 1890, the lines of the 56 principal cities were operated as follows:

	Miles.	Per cent.
By animal power	2,351.10	74 62
By electricity	260.36	8.26
By cable	255.87	8 12
By steam (elevated roads)	61.79	1.96
By " (surface roads)	221.81	7.04
Total	3,150.93	100.00

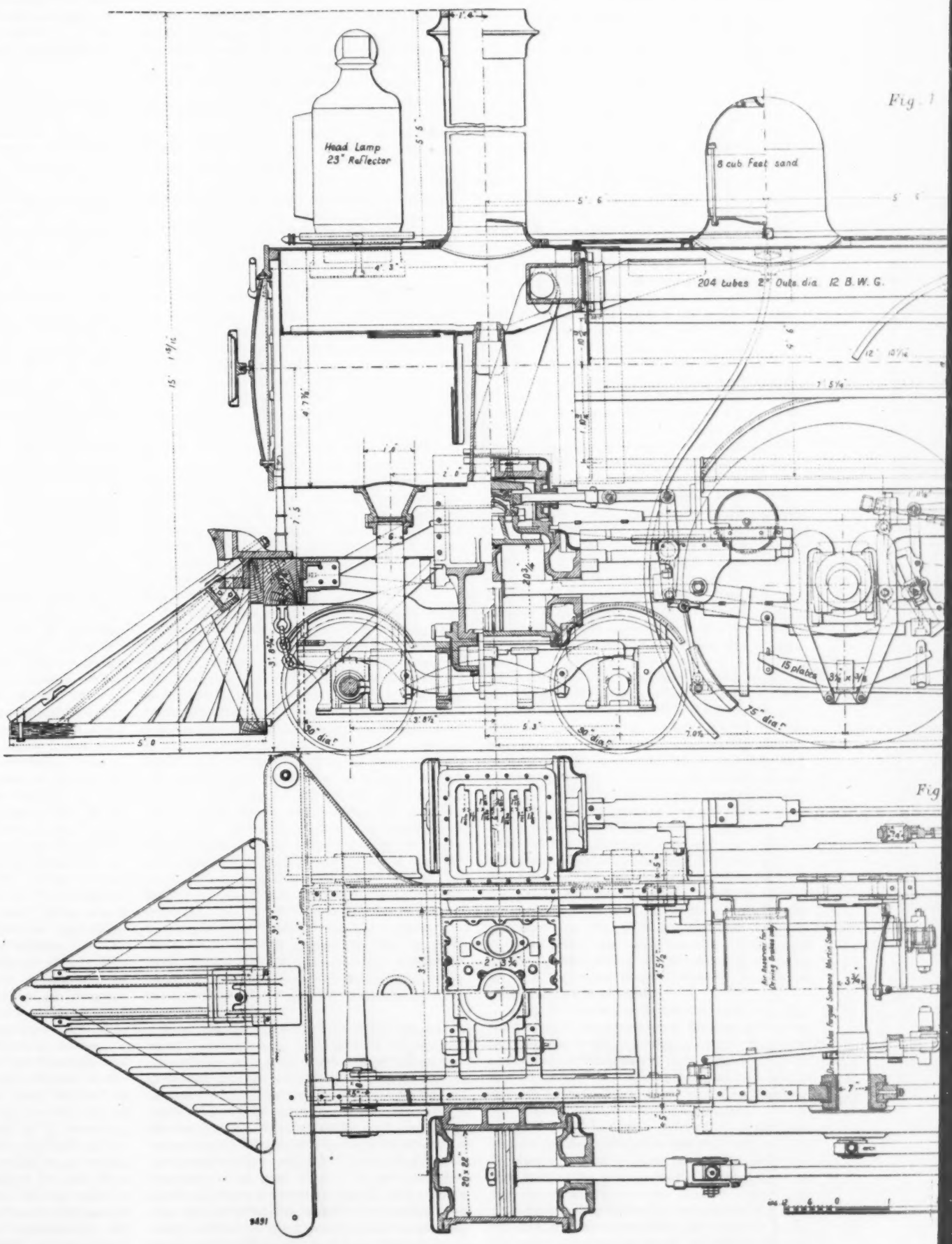
Thus no less than one-quarter of the city railway mileage, and much more than one-quarter of the track mileage and traffic, has already passed beyond the horse-car stage of development; and the electrical mileage, which has sprung up in a day, has already exceeded the cable mileage.

AN inspection of a necessary yet quite unusual type, viz., of the telegraph and telephone poles, was made by the city of Providence, R. I., in January and February of this year. The results are given in last report of the city engineer. It was found that there were within the city 4,978 poles. The location of 551 of these was such that they were merely counted. The condition of the 4,427 remaining poles is given as follows:

Dangerous (one removed since)	4
Doubtful, or likely soon to require attention	159
Fair, being reasonably safe	4,004
Good	260
Total number	4,427

Forty-four poles had apparently been abandoned, and 1,013 had been painted. The wood most in favor was chestnut, there being 3,778 of this material, 463 cedar, 172 spruce, 10 pine and 4 oak. Such inspections as this should be made periodically in all large cities, where similar conditions would doubtless be found to prevail. The number of poles classed dangerous was not large; but not one such should have been found. The number of poles considered in a really good condition, 260 out of 4,427, or less than 6 per cent., is deplorably small. The 4,004 poles classed "fair" were considered so only when the then number of wires and direction of strain was considered. Any increase of strain might prove disastrous to many of these. It is stated that "the heavier lines seem to be in good repair and equal to any strain to be expected in ordinary weather. Only about one-fourth of the poles inspected were found to be painted. Perhaps some of the remaining poles are so located that it matters little whether they are painted or not; but, making due allowance for these, there remains many a weather beaten pole in Providence, the appearance of which would be vastly improved by a coat or two of paint. It

Fig. 1



Fig

TEN-WHEEL LOCOMOTIVE

Fig. 1.

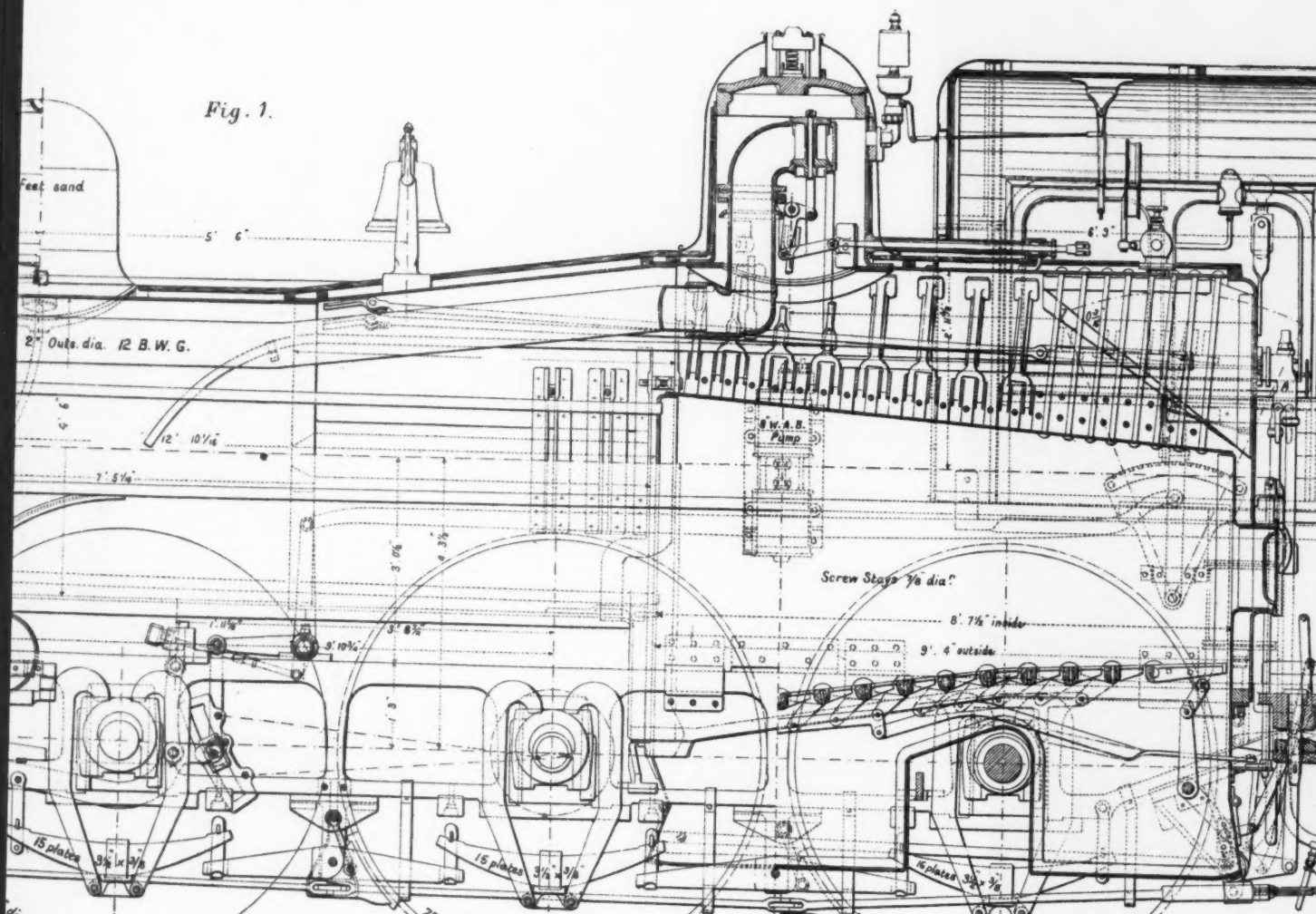
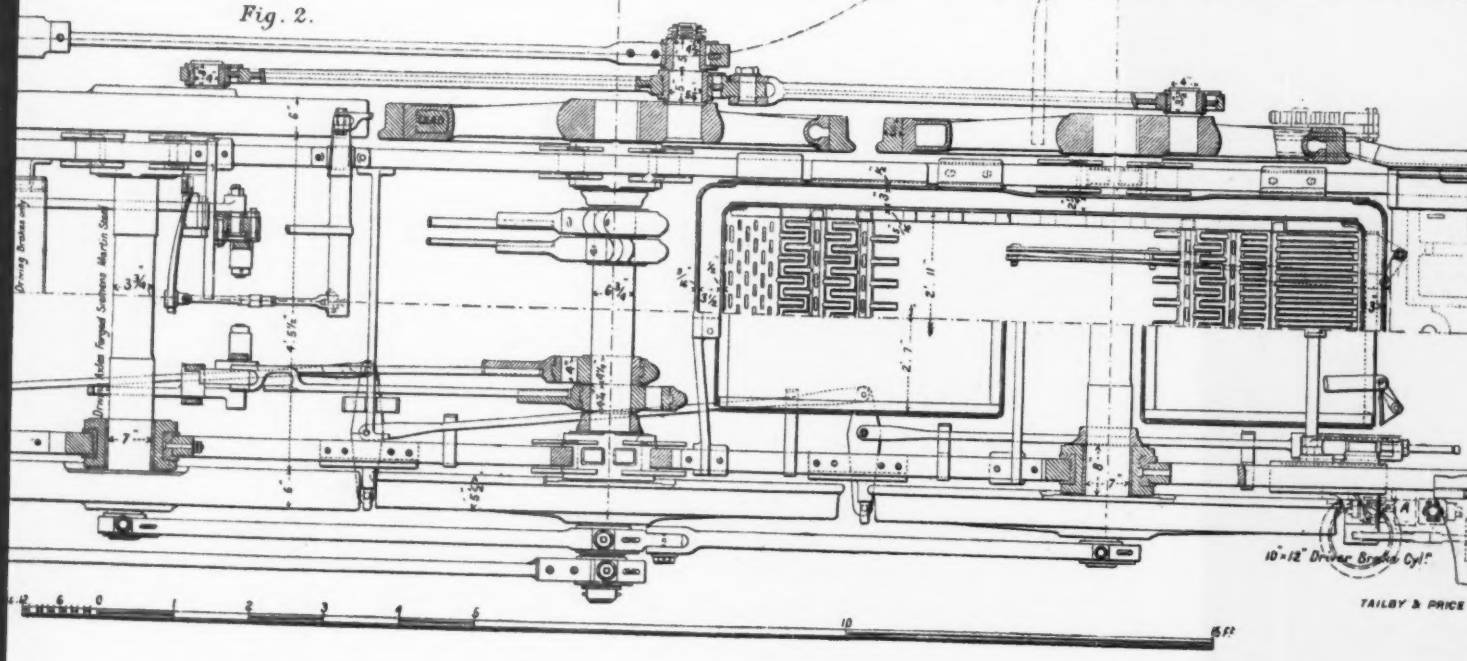
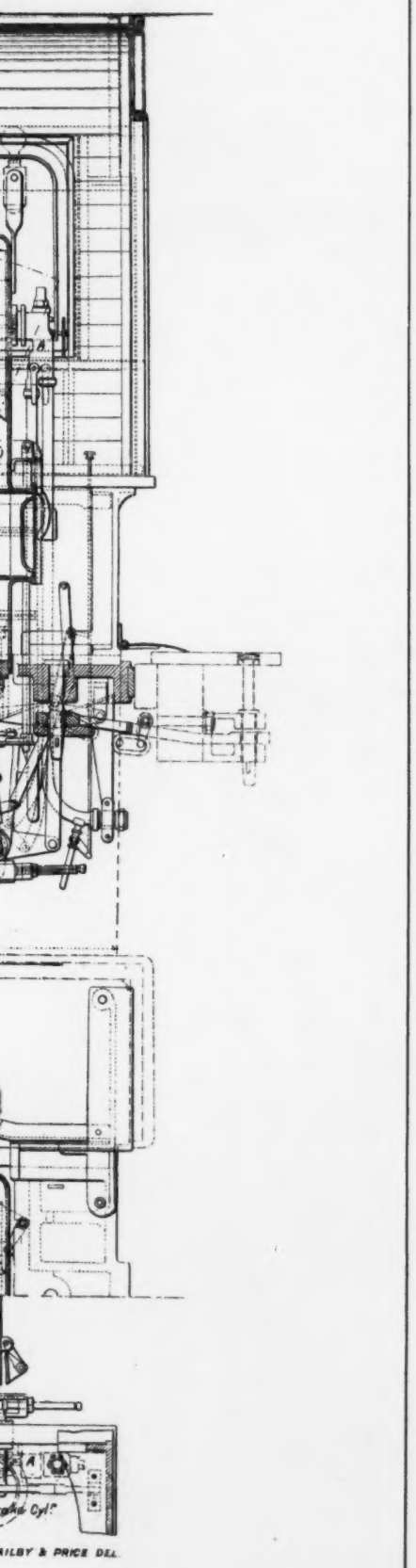


Fig. 2.



LOCOMOTIVE, CANADIAN PACIFIC RAILWAY.



ILBY & PRICE DEL.

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would be but a small return for the privileges granted them if the companies owning these poles kept them well painted, and we suspect that it is the city's fault if they do not, and that some of the poles are in a dangerous, and many others in a doubtful condition.

THE last issue of the New York *Independent*, odd as it may seem for a religious journal, is what may be called a distinctively "railroad number." Its first 12 pages and parts of others are devoted to articles on various phases of the railroad problem, most of them discussing more or less directly the question of State ownership of railways, with a strong leaning in most of them toward such ownership. The issue is another of many signs that the tendency of the times is strongly toward such ownership, with or without a prior consolidation of our railways into a few great systems, which latter is so near at hand that it may almost be said to be in sight. The strongest argument advanced in favor of State ownership is that in the management of the post-office and other practical and non-political affairs the Government is conspicuously successful, and that it would be so with railways. The strongest argument against it is to point to the splendid record of improving service of the past two decades, and ask where, among the railways under public control, like progress can be shown. The problem is still too speculative and remote a one for us to consider it seriously, but that the "stream of tendency" drifts that way must be recognized; and those who take an interest in it will find the last issue of the *Independent* profitable reading.

THE pressing need for some reform in our systems of highway bridge maintenance, as well as of highway maintenance generally, is strikingly illustrated in the letter from Mr. CHAS. F. STOWELL on "A New York Highway Bridge," which appears in another column. Here was a case in which the highway commissioners were so utterly incompetent that, even with the warning of a recent collapse before them, they merely "set the trap over again" by patching up the broken structure with rotten material. It will be found also, by going over any list of highway bridge failures, that this is only an extreme case of the general rule, which is that the defects which cause the failures of highway bridges are gross and patent ones, requiring no very high grade of engineering knowledge to detect them, but only good common sense and a moderate knowledge of elementary engineering principles. Nine-tenths of the highway bridge failures, we believe, are of this character. Of course there are other cases calling for a pretty high grade of professional knowledge in the inspector; but even admitting this, the facts as a whole seem to indicate clearly that the true remedy to be sought is simplicity of administration and concentration of responsibility as to inspections. This is to be obtained most surely by a law creating some such office as a State Inspector of Highway Bridges, it seems to us, to be appointed by the Governor and removable at his discretion, and to be paid a reasonably good salary, with the duty imposed on him of inspecting and reporting in writing on all the bridges in the State as often as he can do so, and not exceed a certain stated minimum of inspections per year. The aim should be, of course, to get a man of high qualifications for this office. No other should be thought of; but our point is that even if he were not so he would pretty surely check the grosser forms of carelessness, and would have such danger of public obloquy hanging over his head if he failed to give warning of danger as to make him very careful. The cost of inspection would also be much less than by any system of voluntary inspection by choice from an appointed list of bridge experts, which latter plan seems to us not a very hopeful one.

The Old Colony Disaster.

The accident which cost the lives of 20 persons on the Old Colony Railroad, at Quincy, Mass., last week was the first one of importance of which we have ever heard that was caused by a track jack, either in place on the rail or between the ties. In fact, serious derailments from accidental obstructions of any kind, other than rocks, cattle and the like, are rare. But even one such serious accident from this cause in 50 years is too many. Moreover, it is very far from being the first accident in which a gang of section hands, working on a double track road, have had their attention so distracted by a passing train upon the other track as to forget to look out for a train upon their own track.

The fundamental trouble on the Old Colony seems to have been that the section hands hardly realized that the jack was an obstruction at all. It was, in fact, a particularly dangerous obstruction, since it not only derailed the front truck, but twisted it so far out of line that almost immediately the locomotive plunged into the bank, and thus formed the fatal obstacle on which the fourth car was crushed. Not a section foreman in the country would have dared put in a new rail at a place like this, where approaching trains could not be seen until within three or four hundred feet, without sending out a flag. Yet, if a missing rail had been the cause of disaster at this point, instead of the fatal jack, it is not at all improbable that every person on the train might have escaped with his life. The jack was permitted to be used without flags out, because it was supposed it could be instantly removed when the train came in sight. It has now been demonstrated by the surest of all proof, practical experience, that this reliance may fail, with most disastrous results.

We trust we are not uncharitable, but it seems to us that it implies something loose in the track practices of the road to have such an accident happen at all. Here was a point in a cut at the middle of a long 4° curve on the most crowded section of a crowded passenger road. The view was somewhat obstructed by an overhead bridge also, and a train became visible at a distance variously stated in the testimony at 300 to 475 ft. Over this distance a train moving at 40 to 50 miles per hour (the most usual speeds *between stations* for all classes of passenger trains) would pass in *from four to eight seconds*, a time which we need not say is far too short for the most active and expert man to make sure of removing a jack from beneath the rails. It is true that he might hear the train for a considerable time before he saw it, but when another train chances to be approaching from the other direction, as chanced to be the case in this particular instance, this aid is denied, and there is nothing but eyesight to trust to. This must frequently happen on the Old Colony, because at Quincy there are at least 75 trains per day in each direction, and possibly at this season of the year as many as 100.

What should be said, then, when one of the most important section foremen on the line, and presumably one of the most competent and experienced, puts one of the most dangerous of all obstructions on the track, without taking the precaution of sending out a flag around the curve in the one direction from which he need fear trains, not so much to warn and stop the train as to double the scanty seconds available for removing the obstruction; or in case of need, to give the train twice as great a distance to stop in? Our observation and understanding is that such omission is entirely contrary to good practice and sound judgment; and that it should have been possible on the Old Colony we cannot but regard as in some degree another of various evidences of an over-conservatism in New England railway management; of a certain inability to realize in season that we are living in the last half and not the first half of the century, and that practice must correspond with modern and not with ancient conditions. It may have been pardonable two or three decades ago to let the trackmen be a little loose in such matters; but in the last four years the Old Colony traffic has increased 50 per cent., and in the last 10 years much more than doubled. What will do very well with 20 or 30 trains per day will not do at all with 75 to 100.

It may be said, indeed, and we shall not deny, that this was merely a piece of exceptional individual carelessness on the part of the foreman; but the circumstances and the testimony seem to make this improbable. Unlike the poet, the section-boss is not born, but made; made by the men whose orders he executes; made by the general spirit of the administration under which he serves. Too often the man is blamed when it is the system which was really at fault; in this case it does not seem to be admitted in the testimony that either was at fault; yet if there be any warrant in good practice anywhere for putting the track in dangerous condition for trains without a flag out, when no warning can come until the train is only eight seconds off, we do not know of it.

Fortunately, it is a comparatively easy matter for any railway manager to make sure that a train shall never be derailed on his road by a jack. In the first place, a chief use of the jack is for lifting track when a rise of several inches is to be made. When this is done the road is, of course, unsafe for trains, and flags are always put out. For ordinary surfacing, where the rise desired is not more than an inch, and flags are not sent out except at specially bad points, many roadmasters prefer to use levers, claiming that the work can be done more rapidly and cheaply, since it takes some time to put a jack in position. The track lever, however, turns two or three men who are paid for working into mere dead weights, and on the whole the jack seems to be favored for surfacing by the most progressive roadmasters with good reason.

But it is certainly quite easy to so control its use that no possible danger shall result to trains. In the first place let us consider the circumstances of this accident. The jack was of the Barrett pattern, and was in position on the inside of the rail. To drop this jack a catch is thrown forward which engages with the pawl holding up the lifting bar. Pressing down upon the handle, then, withdraws the pawl from engagement with the rack on the lifting bar and lets it fall, releasing the jack. But when MICHAEL HARTNEY, the workman in charge of the jack, saw the train coming down on him, this drop hook was not thrown forward to engage with the pawl. He jerked up the handle hurriedly, but the drop hook did not catch, and the train was then too close to make a second attempt. Then, as stated last week, the side of the pilot struck the jack, broke off its foot, and of course tipped it over upon the rail directly in front of the advancing truck wheel.

On the Pennsylvania Railroad it is the rule that the drop hook shall be thrown forward as soon as the jack is in position, so that a single movement of the lever will release the jack. The wisdom of this rule is now thoroughly proved, and had a similar rule been in force here, *and been observed*, this disaster would hardly have occurred.

Again it may be pretty confidently asserted that had the jack been placed on the outside of the rail the disaster would not have occurred. When in that position the lever is away from the track, so that the workman is in no danger, even if the train reaches him before he succeeds in dropping the jack, and he is, therefore, not likely to desert his post. But what is more important is that when the jack is in this position a train striking it is in little or no danger of derailment, since the pilot gives the jack a blow to one side and so pushes it away from the rail. It is objected to the practice of placing the jack on the outside of the rail that it then interferes with tamping the ends

of the two ties between which it is set; but if the ties on each side are tamped, the rail will stay up and the ties next the jack can be tamped after the jack has been removed. Placing a jack between the rails, therefore, should be (and we believe it is) the rare exception.

The trouble, however, with rules that the jack shall have the drop hook in place when in use, or that it shall only be used on the outside of the rail, is that they are apt to be disobeyed. Section hands are not easily held to the fixed methods of work set down in the rules, for no one but the foreman, who is one of them, can oversee them at their work. A spirit of discipline pervading the whole road may do much, but it cannot do everything.

This being the case, if, as we suggested last week, a jack can be used which does not project above the rail level to interfere with the passage of the train, it is certainly to be preferred, provided it is as cheap and equally effective. In another column we illustrate a jack which has been on the market for a number of years, which fully meets this requirement, and seems in other respects to be an efficient tool. Of its service record we are not very fully advised, but we see no reason why it should not have a good one.

It thus appears that in several ways it is possible to prevent the derailments of trains from jacks, and to do it with little expense or trouble. But to do only this and no more is not going quite to the root of the matter. It is a rare and almost unprecedented thing for a track jack to derail a train, It is not so very rare for a party of trackmen on a double track road to step out of the way of an approaching train on one track and be taken unawares by an approaching train on the other track. That this is a great danger to the trackmen is generally recognized; it has not been generally recognized, however, that this also endangers the trains and passengers. The Quincy accident forcibly illustrates that it does so. A tamping bar or pick across the rail might cause as bad a wreck as a track jack, and in how many cases when a locomotive dashes into a group of section hands do they have their tools in their hands? Even when the men succeed in escaping, there may be danger. The testimony of section foremen before the Railroad Commission showed that trackmen would often lay a tool down upon the track while at work, through forgetfulness, and it was often some time before the foreman would notice the infraction of rule and order the tool removed.

The liability of accident from these causes may not be so great as from many others, but it is not too remote to be guarded against. It is very well to look out for the proper use of track jacks, but the broader lesson to be learned from the Quincy disaster is that a spirit of discipline and extreme caution must pervade the working force or no rules will avail, and that better precautions are needed to ensure against the workmen on double track roads from surprise by trains while they or their tools are upon the track.

Water-Works Finances in Detroit.

THE people of Detroit are trying to determine what proportion of the expense of their water-works, which belong to the city, should be borne by the consumers and what by the city at large, that is, by the taxpayers; a question which may well arise in many cities owning water-works, but which so far has been rather neglected. A special committee was recently appointed by the City Council to report upon this subject. The committee thinks that the consumers have been paying too much for water, and that the rates should be reduced; also that consumers should pay two-thirds of the operating expenses, of the interest on the bonded debt, and of the depreciation of the plant, and that the remaining one-third should be raised by general taxation. This seems to be a rather off-hand way of settling so important a question, and it should be noticed that it leaves the taxpayers to raise money for a sinking fund, or to pay in some way the cost of the plant. There can be no doubt but that the current cost of fire protection, street-sprinkling, sewer flushing, water used in public buildings and fountains should be paid by general taxation, whether it be a third or a half of the total cost of water service. Private consumers should pay according to the amount used, and we fear that satisfactory rates will never be established until meters are employed to measure all water consumed. Even then the rates may not be satisfactory, but they would be at least just if good meters were used.

So much for the operating expenses of the works. As regards water for public purposes, the taxpayers should, of course, pay their share of the interest on the bonded debt, redeem their share of the bonds, and provide for their share of the renewal of the plant. This principle the Detroit people would willingly accept, judging from their committee's report. Their dissatisfaction arises at the point where the private consumer begins to pay for the construction of the plant, either by the application of part of the revenue to the payment of the bonded debt, or its application to the cost of new construction in the way of extensions or improvements. The only reason why private consumers should not pay the full cost of the plant, so far as it is constructed for domestic purposes, is that the works are the property of the city as a whole, that they increase the value of city property, and that non-consumers are benefited by them, and should contribute something toward their support. How much they should contribute it is not easy to say, but it could perhaps be determined by ascertaining the value of all private property supplied and all not supplied, and levying a tax upon property not supplied proportional to the benefit it receives from the mere existence of water-works. We suspect that an attempt to do this in Detroit would cause much more dissatisfaction than now exists there.

Judged by the rates in other cities, and by the average of the rates in nearly 800 cities in the United States and Canada, the Detroit rates are not high. THE MANUAL OF AMERICAN WATER-WORKS for 1889-90 shows that the family rates in Detroit, including the seven items of general family rate, one water closet, bath tub and wash-bowl, horse and carriage, cow and sprinkling hose for lawn, are $20, against $20.05 as an average of 36 works in Michigan, and $26.88 for 748 works in the United States. These averages, however, include the rates charged by private works, which are higher than those charged by public works; but leaving out the private works we have the average charge for family purposes for 25 Michigan public works, $19.60, and for 334 public works in the United States, $21.55. Detroit charges but 10 cents per 1,000 galls. for metered water against from 30 to 15 cents as the average range or scale in Michigan, and about 37 to 19 cents in some 750 cities throughout the United States.

The annual report of the Detroit Water Commissioners for 1889 shows that the total receipts were $482,664, of which $394,063, or 81.6 per cent. was from private consumers and included penalties for shutting off water and labor and material paid for by consumers. Of the remainder $74,277, or 15.4 per cent., was from the city tax levy, and $14,324, or 3 per cent., from interest, rent, plumbers' licenses and material sold. Against this we have the total expenses for the year, $313,307; $102,587 for operating expenses, $133,355 for construction, $75,340, interest on the bonded debt, $1,000 bonds paid and $1, 25, Hurlburt fund, evidently for maintaining a library. This leaves a surplus of $169,357 to be applied to the payment of the water debt and to the cost of future extensions. Considering only the revenue from private consumers we find that this is $30,756 more than all the expenditures of the works for the year, including interest and construction; and deducting the $1,000 of bonds paid at this rate the principal of the bonded debt might be paid by the consumers alone in 16 to 17 years. The total surplus would pay the remainder of the bonded debt in less than eight years.

From the above it would appear that Detroit can well afford to lower her water rates, which are shown above to be low already. But what change, if any, she should make in the amount raised by taxation it is hard to say. We have seen that this is 15.4 per cent. of the total revenue. It is nearly three-fourths of the total operating expenses, within about $1,100 of the interest charges on the bonded debt, and over 23 per cent. of the operating expenses, interest charges and cost of construction together in 1889. There were in the city, at the close of 1889, 1,818 fire hydrants and 419 cisterns. The relative cost of the two are not given, but probably more water is used from the hydrants. But classing them together as 2,237 hydrants, we should have a total revenue from the city, or directly from the taxpayers, of $33 per hydrant. The average hydrant rental for 544 water-works in the United States, as given in THE MANUAL OF AMERICAN WATER-WORKS for 1888, is $50. Nearly all of these are charges by private companies, and for such companies the family water rates in the 1889-90 MANUAL are shown to be 43 per cent. higher than the rates charged by public works. Therefore, if $50 is the average hydrant rental in the United States, $35 may be taken as the probable prevailing price when an allowance is made by public works, and the Detroit price is only a little below this, $33.

From these consideration it would seem that a sufficient amount is now being raised by general taxation, and that to increase the amount to one-third of the operating expenses, interest on the bonds and depreciation of the plant, leaving the whole of the cost of new construction and the payment of the remainder of the water debt as an additional sum to be raised by general taxation, would be altogether too great a burden upon the property of the city, and certainly more than other cities are paying.

So far as their reports indicate, very few cities attempt anything like a scientific solution of the question we have been considering, but it is an important one, and one upon which we may be able to shed more light when sufficient data are collected to present the practice in a considerable number of cities.

Notes Abroad—In Greece and Egypt.

[EDITORIAL CORRESPONDENCE.]

(*Continued from page* 171.)

As most people know, the great Pyramids of Gizeh and the world-famed Sphinx lie within 8 miles of Cairo, just within the edge of the Lybian Desert, and, of course, we visited them. To do the most in the least time we had, immediately on our arrival here secured the services of a dragoman, a certain Said Mansour. This Said was an impressive-looking Arab, with baggy purple breeches of the amplest cut, embroidered waistcoat of the finest Egyptian silk, turban, sash and all the other paraphernalia considered essential to attract the tourist's eye. Said had a frank and taking manner about him that attracted us at once, and it was only later that we found we were being cheated right royally, and that his taking manner was more realistic than was desirable. But he had one redeeming quality that probably squared our accounts and that was that he proposed to do all the swindling himself and most vigorously resisted like attempts on the part of other too ambitious and avaricious Arabs.

Under the guidance of Said we made an early start for Gizeh, and at 6 A. M. we stood at the foot of mighty Cheops. Then our troubles began. Visitors are scarce hereabouts in July, and the so-called tribe of Pyramid Bedouins assailed us in full force, determined to make the most of an unexpected windfall. After much dispute and yelling, and what sounded like very wicked Arabic, the shiek of the tribe selected for each of us three lusty assistants

one grabbed each wrist and a third followed close behind ready to hoist us with head or hands as he saw fit. The steps to be mounted were each from 2 to 3 ft. high, and were of rough Mokattam limestone laid with an abundance of a very hard mortar; the height ascended was about 450 ft., and our Arabs were in a hurry. We finally reached the top, however, breathless and perspiring at every pore, and, speaking for myself alone, a double, back-stitched vow was registered that if I ever climbed Cheops again it would be in the winter months, and armed with a shotgun to enforce obedience among my wild crew of helpers. But, like true American tourists, "we did it," and practically had the sentiment of doing it for our pains. It was too early and too misty for anything like an extended view, and the outlook half way up was quite as good as that from the summit. The descent was almost as trying as the ascent, and curiously enough when my two friends and myself got together to compare notes, we found that we had each been assisted by the veritable Arab mentioned by "Mr. Markee Twainee," and were each confidentially informed that any other son of the desert claiming that honor was a swindler and a liar We agreed with the gang, taken collectively, in the latter sentiment. Several Arabs were also anxious to risk their necks in that other feat of Mr. Twain's of running to the top and down again in 12 minutes for two shilleio. Had we been sure that they would have succeeded in dislocating their rascally vertebræ in the course of the climb, we should have considered the experiment cheap and entertaining at double the fee. But warned by the lack of success attending Mr. TWAIN'S endeavor, we kept our money in our pockets.

Our next visit was to the Sphinx, and here, to honestly express my convictions, I was disappointed. We were fortunate in finding this famous monument excavated to the level of the base; but as we stood in front of it on the normal desert level, we were about on a line with the nose. The figure is said to be 66 ft. high, and the face alone is 14 ft. long, but it is dwarfed by Great Cheops and its companion pyramids in the immediate background, and the impression of mass and grandeur expected from the representations we had seen was not realized. The face, which is the only portion really cut with any care, may once have been beautiful, and the smile "winning;" but an iconoclastic Arab sheik has destroyed this beauty in great part by cutting off the nose, and Mameluke cannon and the rasping tooth of time have about completed the destruction of what may well, one time, have been features of surpassing grandeur. It is still a wonderful monument; but it is now neither impressive nor beautiful.

In an evil hour we concluded to extend our visit that same day to Sakkara and the ruins of ancient Memphis; a determination which was supposed to mean, at the start, an 8-mile ride on Cairo donkeys, but which actually resulted in extending our donkey ride to 17 miles, under a July sun, with the thermometer at about 120° F., and for more than half of that distance our path lay through the borders of the Lybian Desert. Before we finished our day's excursion some of us concluded that there were other donkeys present besides those between our legs.

I might say right here, before I forget it, that we were all ambitious, in the early morning, to take an airing on a camel, and our faithful Said remarked that he could secure camel transit for us from the Mena House, where we had breakfast, to the Sphinx, a distance of a few hundred yards, and Said added, with a wicked grin and a knowing wink of his bright little eyes, that that would be "plenty of camel." We did not ride on the camels. We had our "plenty" in watching the experience of a less cautious native of the German Fatherland. In the first place a Cairo camel is not a clean beast, and the garments of his Bedouin master and the heap of dirty rags mysteriously lashed to the camel's one awkward hump are entirely too suggestive of—a bite. The camel kneels to be mounted; but just about the time the unsuspecting rider comforts himself with the thought that he is safely "aboard," the camel suddenly develops a most bewildering and nerve-trying trick of getting up hind part first, with the result, in this particular case, of landing our innocent German friend on the crown of his head after sundry ungraceful gyrations. In motion, the camel walks all over, and its chief endeavor seems to be to jerk the head off of the rider who has not yet learned to accommodate himself to the "gliding movements" of the beast. We were told that we would soon get used to these and other eccentricities of the camel; but after due deliberation we concluded to defer any personal experiments until cooler weather.

A ride on a Cairo donkey, with a Cairo donkey-boy as its attendant is also not without its sensations and experiences. The donkeys left to themselves amble along at a fairly comfortable gait; the rider holds a rein, and by great effort can change the direction of his course, but otherwise he is helpless. The donkey understands Arabic only and understands better than anything else the whack of the donkey-boy's stick that is usually applied at the most unexpected and inopportune moments, from the rider's standpoint. The donkey boy himself is a wonder. Through all that 13 hours of African sun, and barefooted over the stones and burning sands of the desert, my boy was yelling at or punching the donkey I rode, and urging it into an uncomfortable gallop. No matter at what speed the beast was going, the boy, with his tongue out and his black face shining with perspiration, stuck close to its flank, and he never seemed happy except when he and his donkey were on a run. Their wind is something phenomenal, and their little legs must ensheath muscles of steel.

For details of what we saw at Sakkara, at the the Serapeum, the tomb of Ti, etc., I must refer the reader to current works on Egyptian monuments, or to Baedeker's Guide. Of pyramids we visited or passed no less than 11, any one of which would be remarkable had we not first seen those of Gizeh. We traversed underground passages which still contained 24 of the huge sarcophagi which once held the Apis or sacred bull mummies. These enormous coffins of granite average 13 ft. in length, 7 ft. in width, and 11 ft. in height, and are said to weigh 65 tons each. How they were placed in the rock-hewn chambers where they now stand was a mystery we could not unravel. They bear the names of Cambyses, Darius, and Xerxes, the Persian rulers of Egypt 2,300 years ago. In the tomb of Ti, the walls of light yellow stone are covered with remarkable delicate, flat bas-reliefs, very sharp and distinct, and depicting scenes in the life of Ti himself, who lived in the 5th Dynasty, or 4,500 years ago! It is typical of this slow-moving country that on these walls one can see almost exactly the same plow, the same hoe and sickle that are used to-day in Egypt, and the buffalo and ox, the goat and the donkey of the present time, are also faithfully outlined. The work looks so fresh, and the colors are still so bright in places, that it is difficult for the American to realize that 45 centuries have passed since the workmen finished their task and Ti was committed to his tomb.

Of Memphis, the city founded by Menes, who is placed by the Egyptians at the head of all their dynasties, little remains save piles of brick, broken pottery and fragments of granite; but these cover a vast extent of country. The one impressive reminder of its ancient state is a colossal statue of Rameses II., "the Pharaoh of the oppression." This figure was 42 ft. high, but is broken at the knees and now lies prone on its back. It was buried until 1820, and this fact and its material, a remarkably hard and fine-grained granite, account for its almost perfect preservation. The workmanship upon it is admirable, and it looks like a strong portrait of a strong man. In the Museum, in the Gizeh Palace at Cairo, we saw the mummy of this same Rameses II., the Great, who was king over Egypt B. C. 1400, a blackened reminder of the man who "ruled Israel with rigor," and made heavier the task of the Jews by compelling them to provide the straw as well as the mud wherewith to make bricks for their oppressors.

We missed our train on the Lybian side of the Nile, and were compelled to cross in a native boat and ride five miles over a burning plain to the railway station at Helouan, where we again missed a train by ten minutes, and were compelled to wait some hours in the hottest railway station fate ever threw us into. We finally got back to Cairo, tired and sore, but otherwise none the worse for a somewhat reckless expedition at this season of the year.

We returned to Alexandria by way of Ismailia and one-half of the Suez Canal to Port Said, and thence to our destination by one of the passing steamers. We made the trip in the canal by a small but reasonably fast mail-boat. The northwest wind prevailing at the time made our passage comfortable. We passed en route about five large steamers bound in either direction, and in that distance saw seven French dredges hard at work deepening and widening the canal. At the points yet untouched by this new work it was evident that there was a very considerable undermining and cutting of the bank by the wash of passing steamers and all manner of temporary expedients had been employed to break the force of the waves. For this purpose reeds had been planted, board breakwaters put up, posts driven and interlaced with reeds, and walls built of small blocks of cement. In one place we noticed rusted-out metallic railway ties applied to this same purpose, just as we saw these same metallic ties extensively used along the railway to Ismailia to prevevent the blowing sands of the Arabian desert from encroaching upon the numerous and sometimes deep cuttings. These ties seemed to be deeply corroded by rust, and the slots for the rail fastenings were badly worn. It is difficult to tell in most cases how the Egyptian railways are supported, as the gravel ballast generally used covers the substructure entirely. But we certainly saw timber ties in use at some places, and saw great quantities of the cast-iron potsleeper in store along the lines.

To return to the Suez Canal, the sides now for a considerable distance east of Port Said are being lined with a rough but substantial dry wall of stone, extending about 4 ft. above the surface, that will effectually stop the wash. Along the older portion the canal is not an impressive piece of engineering; though every engineer must realize what it cost in life and treasure to cut this ditch through a desert of sand and through vast but shallow lakes of brackish water. The deepest cutting is only 53 ft., not far from Ismalia, seemingly nothing at all when compared with the Culebra cut of the Panama Canal, the work on the Nicaragua, or even the deep cut of the Corinth Canal. Port Said is a town born of the canal; but it is a very busy place, with dozens of colliers unloading their cargoes and vessels constantly coming in from the east or the west, receiving their supply of fuel, carried aboard in baskets on the heads of a swarm of Arabs, and then away again to the ends of the earth. The now almost universal use of powerful electric lights on the bows of passing steamers has practically doubled even the present capacity of the canal by permitting night passage.

But time presses and the mail awaits, calling for a close to this letter. We are off for Constantinople next, and if anything of interest presents I will submit it.

D. McN. S.

CORRESPONDENCE.

The Accident on the Mt. Penn Gravity Railroad.

READING, Pa., Aug. 22, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: A disastrous accident occurred on the Mt. Penn Gravity R. R., near this place, about 11 A. M. to-day, by which the conductor and five others lost their lives and a great many others were more or less seriously injured. This road, as you will doubtless remember, encircles Mt. Penn, forming a complete loop eight miles in circumference, up the first half of which the cars are hauled by a locomotive, descending thence by gravity to the point of starting. On the down trip of the car in question the brakes became unmanageable, and the car steadily gathered headway until finally, at a speed of about 50 miles per hour, it jumped entirely clear of the track and plunged headlong down the hillside, rolling over and over until brought to rest among the fallen trees bottom-side up. The car was equipped with an Eames vacuum brake, which did not work, probably owing to faulty adjustment. The place of the accident is an *alarmingly* dangerous one. It is at the end of the trip, very near the starting point, but 80 ft. or more up the mountain side; and in order to get down the road makes a number of complete turns of 180° with 75 ft. radius curves and a continuous grade of from 3% to 4%. Where the accident occurred it was 6%. The accident occurred at the beginning of this abrupt descent, where, on about a 4% grade, a tangent changes *immediately* to about a 70° curve with a central angle of about 180°; the back of the curve facing down the hillside, the slope of which is at least 30°. The outer rail is only elevated a few inches, and the distance between trucks is about 25 ft. The curve is provided with an inside and outside guard rail, *but at the most dangerous*

part, the beginning of the curve, the outer guard rail is omitted. The car left the track the *moment it struck the curve*, and plunged straight down the hillside. The blame, of course, lies primarily in the road itself, as a much safer and better line is possible, though, of course, at greater expense in land damages and possibly in construction. But also the management seems to have exhibited a remarkable lack of forethought in not properly protecting such dangerous places against such possible contingencies; in failing to have their cars supplied with the most approved automatic brakes and clutches (the road has been in operation nearly one year, and has only within the last two weeks been supplied with the Eames brake above mentioned); and finally in failing to have a skilled and competent man to *closely* watch the condition of whatever brakes the cars were supplied with. The brakes had been on so short a time that no official from the superintendent down seems to have been familiar with them. S. W. F.

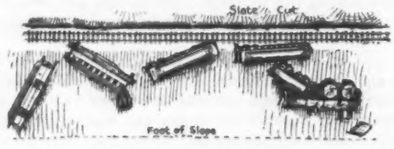
A Harmless but Instructive Wreck.

CHILLICOTHE, O., Aug. 11, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: A wreck occurred about two miles west of here Sunday night, at a point called Slate Cut, which was peculiar from the fact of the general dismemberment of the train, with no loss of life and so few injuries.

The cut is through shale, which has so badly disintegrated as to commence to fall off in large masses, and Sunday evening, Aug. 9, a farmer discovered the track to be



Sketch Plan of Wreck.

full. The Loveland camp-meeting train, due here at 9 P. M., was heard approaching and signaled with a lantern, but for some reason paid no attention, and as the passing train blew out the lantern the train jumped the track, piling up, as shown in sketch. While the engineer and fireman claim to have kept to the engine, it seems likely, from all that could be learned, that they jumped as soon as the engine left the track.

One lady was badly cut in the face, while the engineer was somewhat scalded.

The Janney coupler from the baggage car had pulled apart one side of the link by which it was fastened to the tender, and then pulled loose from the car, but none of the parts of the coupler were broken and none on the whole train were injured. It is quite remarkable that none of the cars telescoped.

Why the engineer paid no attention to the signal is a mystery, as the fireman admits having seen it.

That there were no fires on the cars was a great factor in the small loss both of lives and of property.

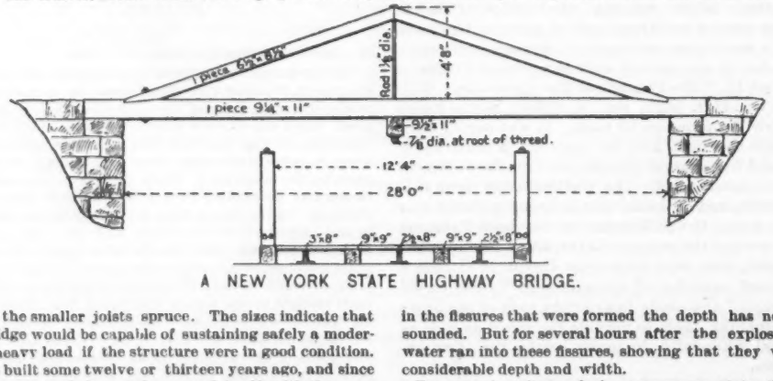
SUBSCRIBER.

A New York Highway Bridge.

ALBANY, N. Y., Aug. 16, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: I inclose herewith a plan of a small highway bridge which has recently been brought to my notice. The timber in the trusses, needle beam and large joists is oak,



A NEW YORK STATE HIGHWAY BRIDGE.

and in the smaller joists spruce. The sizes indicate that the bridge would be capable of sustaining safely a moderately heavy load if the structure were in good condition. It was built some twelve or thirteen years ago, and since then has been left to take care of itself with the occasional intelligent (!) assistance of the highway commissioners. In the course of time decay began to get in its work on the timber, and it is likely some of the nuts worked loose also. At any rate the condition of the bridge was such that when on Aug. 3 a portable engine, used for driving a threshing machine and weighing, perhaps, 40,000 lbs., attempted to cross, the structure broke down, wrecking the engine and badly injuring the driver. The indications are that the trouble was caused by the failure of one of the main braces. The highway commissioners immediately proceeded to put the bridge in shape, and it is now open to public traffic again. Upon examination I find the condition of the bridge to be as follows:

The main suspender rods, short as they are, have been welded up from still shorter pieces. One weld is bad, showing an open crack extending at least a quarter of the way through, and no one knows how much farther.

Of the woodwork, the plank and small spruce joists are good, but every piece of oak in the bridge is badly decayed. The straining beams or chords are very rotten, especially at their weakest points; that is, where the shoulders are cut for the main braces: not more than half the original section is good. At one corner more than half of the shoulder itself is gone; rotted off. One of the straining beams has some grass growing on it.

The main braces are all pretty far gone, but the new one just put in is much the worse of the lot. This is an old, weather-beaten stick originally of the same size as the other brace, apparently, but the corners are all rotted off, giving it an oval shape. It is also rotten in the center. Probably about one-third of its original section is sound.

The needle beam is rotten at its core and the 9 × 9-in. joists are very badly decayed. They are pieces of some old bridge.

Now this, mind you, is a bridge *fresh from the highway commissioner's hands*, and which the public is invited to use without restriction. It is a death-trap, and no doubt has been one for a long time. Having caught one victim, it has been immediately reset to catch another.

This bridge is located in the town of Guilderland, Albany Co., N. Y., on a public highway about two miles from Vorheesville, and the same distance from Guilderland Centre. It is a fair sample of the condition that ordinary country bridges are liable to get into under the present system of control. Nothing else need be expected until all highway bridges are placed under some sort of competent supervision. In time this will probably be accomplished, but in the meantime those who have occasion to travel within the jurisdiction of the highway commissioners of the town of Guilderland will do well to ford the streams. CHARLES F. STOWELL.

The Indiana Natural Gas Explosion.

KUSHVILLE, Ind., Aug. 20, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: The people of Southeastern Indiana have been greatly excited recently over an explosion of natural gas which took place about three miles south of Wal Iron, a small village on the "Big Four" road in the southeastern part of Shelby Co. The explosion occurred about nine o'clock on the morning of Aug 11. It uprooted large trees and hurled them many feet from where they had stood, made great fissures in the earth and did a great amount of damage in a small territory. The land affected by the explosion is in the bottoms of Big Flat Rock River at a place where the stream makes a horseshoe-shaped bend to the north. Conn's Creek flows into the river at the toe of the shoe, and the public road crosses the river at about the same place and follows up the river inside the horseshoe. The stream is about 100 ft. wide at this place, and the distance across the bend is 500 to 600 ft. The point where the greatest power and destruction were manifested is in the public road, nearly 600 ft. from where the road crosses the river, and this point is now under water.

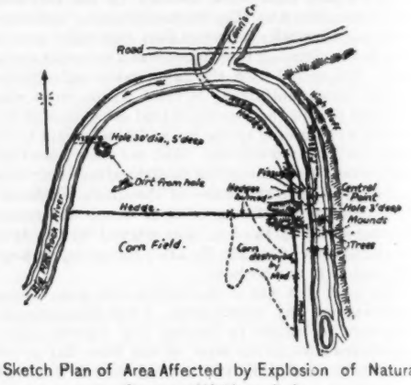
Before the explosion the bank at that point is said to have been about 3 ft. above the water, where now an area of 400 to 500 sq. ft. of ground is 6 to 8 ins. under water, and in the fissures that were formed the depth has not been sounded. But for several hours after the explosion the water ran into these fissures, showing that they were of considerable depth and width.

Persons who witnessed the occurrence state that the first intimation which they had of anything unusual was a sound as of the escape of pent-up steam from the safety valve of some mighty engine and then came the flame, which burned to a height of 200 ft. or 300 ft., and which was enough to appall the stoutest heart. The gas was ignited from a burning pile of drift wood, and scorched and burned the leaves on the trees for a distance of 500 ft. to the south of the main or central point of the explosion, while a hedge fence which ran along the west side of the road and one which ran west from this, together with the willows which grew along the river, were completely burned up.

The fissures seem to run to the north and west from the main part of the explosion spoken of above, and on the bank are from 2 ins. to 3 ft. in width and from 3 to 6 ft. deep. One great fissure extends in a northern direction for a distance of 350 ft., crosses the river, and terminates about half way up a bluff nearly 80 ft. in height. Where it terminates it is 10 ft. wide, but does not appear to be deep.

Near the central point spoken of and about 60 ft. southwest a great hole is blown out and the dirt from it is piled on the south side in three mounds 6 to 8 ft. high and 20 ft. in diameter at the base, the bases touching each other. A tree 2 ft. in diameter, which stood on the river bank near the main part of the explosion, was blown out east into the river 25 ft., while one 18 ins. in diameter which stood about 20 ft. beyond the first was blown south a distance of 100 ft. into the river.

A large amount of blue clay was blown out by the force of the explosion, while mud and water were blown all over three or four acres of land, denuding large trees of their branches and entirely destroying at least two



Sketch Plan of Area Affected by Explosion of Natural Gas near Waldron, Ind.

acres of corn which grew across the road from the river. The fissures extend north and west, while the dirt, mud and water were blown to the southwest.

On the lower side of the bend and nearly 500 ft. from the central point spoken of a hole 30 ft. in diameter and 5 ft. deep is blown out, and a part of the earth from it, perhaps 10 cu. yds., landed 100 ft. southeast, still retaining the shape of the side of the hole.

Prof. JOHN COLLETT, our State Geologist, attributes the explosion to an enormous pocket of natural gas. It burns without odor, and so cannot be from Trenton limestone. There is some gas still escaping a flame about 10 ins. high burns from a 2-in. pipe, one end of which is buried in a fissure, while a small amount of gas bubbles up through the water in many places.

Quite a number of gas wells have been drilled in that section of the country; the nearest to the scene of explosion is about 2½ miles. All the wells were shot. They yield only an ordinary flow of gas. Herewith is given a rough plat of the territory affected.

I send you by this mail four photographic views of the scene. It is estimated that 20,000 people visited the place on Sunday, Aug. 17, and great crowds have been there every day since the explosion. M. H. DOWNEY.

[The views inclosed, while not seeming to show enough more than our correspondent's clear description to make them worth engraving, show a very decided and general break-up of the surface, indicating that the force of the explosion must have been very great.—ED. ENG. NEWS.]

Notes and Queries.

READER asks if Mr GEORGE STRONG, the designer of the Strong Locomotive, is an American or an Englishman. He is an American.

VARIOUS INQUIRERS as to employment are notified that all this journal knows about positions vacant is announced in our want columns. In the not infrequent cases when we are applied to for men to fill vacancies of various kinds we invariably insert some notice in our want column to afford all applicants an equal chance.

L. C. F. writes: Please advise me what is the latest improved lime kiln, in what manner it is constructed, cost of construction and where I can obtain plans and proposals for the erection of one or more kilns. Also advise if coal can be used as fuel for burning lime in what is known as the patent lime kiln.

[We shall have to trust to our readers to inform us of the proper answer.]

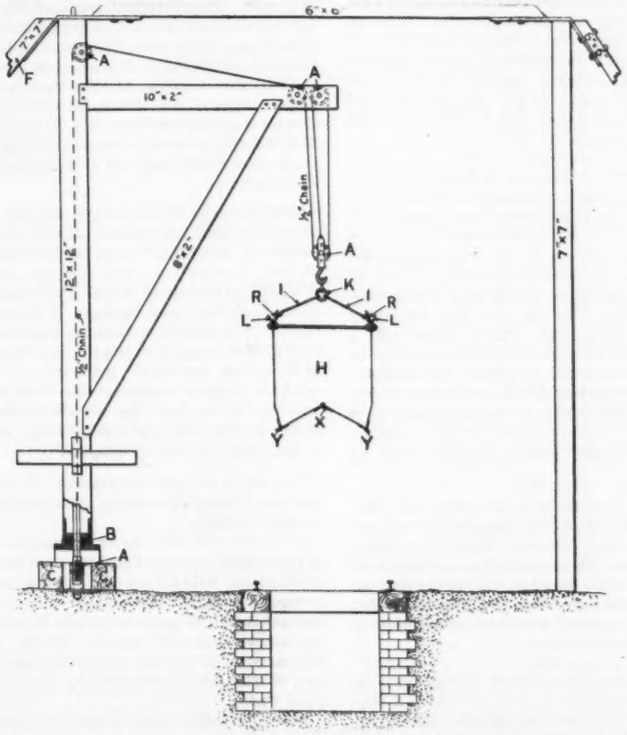
H. E. B. writes from Bay City, Mich.: I inclose photo from drawing of a riveted bridge to be built at Belinda

St., in this city. The bridge proper consists of 2 fixed spans, each 143 ft. long; 1 plate girder span, 70 ft. long, and 1 swing span, 260 ft. long. All 20 ft. clear roadway and 2 ft. 6 in. walks. I wish to inquire if you know of a longer riveted draw in the United States. [We think there are longer, but do not recall where, and cannot determine without search of records. Some of our readers can doubtless speak with more certainty.—ED.]

Cinder Loading Plant, Cincinnati, Washington & Baltimore Railroad.

We are indebted to Mr. EDWARD EVANS, Master Mechanic of the Cincinnati, Washington & Baltimore Railroad, for the accompanying sketch of a neat and handy contrivance for disposing with the least possible labor and inconvenience of locomotive cinder. The main idea of the device is to catch all ashes and cinder in a bucket just fitting the usual pit, and make the nearest switch engine do the hoisting.

To this end a ¾-in. hoisting chain is passed over the pulleys *AAA*, the further end of which is attached to any locomotive. A ball bearing, *B*, is placed under the foot of the mast to enable it to revolve easily. The lower pulley, *A*, beneath the mast,



CINDER LOADING PLANT, CINCINNATI, WASHINGTON & BALTIMORE R. R.—EDWARD EVANS, MASTER MECHANIC.

is swiveled so as to follow the direction of the pull, whatever it may be. The bracing and support for the mast can be arranged, of course, to suit the locality.

The bucket *H* is 8 ft. long, and 3 ins. less in width than the width of the ash-pit. It is made of old tank iron, well braced, with two rods running across at the top of the bucket. Double rings *h* for hoisting are secured at the top of the bucket by two nuts at each end of these rods. Four hooks *I*, attached to the central hoisting ring, *K*, engage with these rings. After the bucket is placed in the pit the hooks are detached at *R*, and the crane is swung to one side. There is a flaring flange, *L*, at the top of the bucket to keep the ashes from getting between the side of the bucket and the pit.

The bucket has a drop bottom for its full length hinged at *X*, with a clasp at *Y*. An empty coal car is placed in a track to the left of the crane, the bucket raised, the crane swung around, the clasp at *Y* released and the ashes dumped at once; the whole operation, including return of the bucket to the pit, being performed in about four minutes. It is noted that water should be convenient and the ashes well wet down to prevent their setting fire to the car. The device as a whole seems simple, cheap and meritorious.

Growth of the Pig Iron Production.

The Census Bureau has again showed commendable promptness in getting out Census Bulletin No. 9, showing the growth of the pig iron industry since 1880. The information is of less importance than for many other industries, because the iron statistics of all kinds are so well gathered yearly by the American Iron & Steel Association. But this bulletin is even more prompt than theirs, containing full statistics up to June 30, 1890, while it is dated and was issued Aug. 20; the Iron & Steel Association's statistics not ordinarily becoming public for some months later.

In our issues of Feb. 1, April 5, May 10 and 17 we gave many statistics which are useful for comparison with these now issued, which show an amazing increase over the calendar year 1889, although for a year only 6 months later.

	Gross tons.	Net tons.
Our production for the year ending June 30, 1890, was	8,553,774	9,579,779
For the calendar year 1889	7,604,525	8,516,079
Increase, due to 6 mos. later date (1 ½/6)	948,849	1,063,700

This is at the rate of over 25% per annum, whereas between 1888 and 1889 it was *only* 17%. The estimated British output for 1889 (estimated by the Am. I. & S. Ass'n., very closely at 8,300,000 gross tons) was only 8,322,824 gross tons, which our census year, ending June 30, 1890, surpasses.

The more important parts of the Bulletin, considerably condensed, are as follows:

The production of pig iron during the census year ended June 30, 1890, was the largest in the history of the iron industry of this country, amounting to 9,579,779 tons of 2,000 lbs., as compared with 3,781,021 tons during the census year 1880 and 2,092,821 tons during the census year 1870. From 1870 to 1880 the increase in production amounted to 1,728,200 tons, or nearly 85 per cent., while from 1880 to 1890 the increase was 5,798,758 tons, or over 153 per cent. The following table shows the production of pig iron in the various sections of the country, in tons of 2,000 lbs., including castings made direct from the furnace. The statistics for 1870 and 1880 are for the census years ended May 31, but for 1890 they cover the year ended June 30.

Tons of 2,000 lbs.

Districts.	Census year of 1870.	1880	1890.
New England States	34,471	30,937	33,781
Middle States	1,311,649	2,401,093	5,216,591
Southern States	184,540	350,436	1,780,909
Western States	521,161	995,.35	2,522,351
Far Western States	.....	3,300	26,147
Total	2,052,821	3,781,021	9,579,779

It will be seen, that the pig iron industry of New England has been practically stationary during the past 20 years, while during the same period, and especially since 1880, there has been a wonderful development of the manufacture of pig iron in all other sections of the country.

In 1880 the pig iron industry was located in 24 States and 1 territory, but pig-iron was produced in only 22 States, the furnaces in Minnesota, North Carolina, and Utah being idle in that year. In the census year 1890 there were 25 States which contained completed blast furnaces, and pig iron was made in that year in each of these States, except Minnesota. Since 1880 the manufacture of pig iron has been abandoned in Vermont and Utah, and during the same period two States, viz., Colorado and Washington, have engaged in its production. In the census year 1890 Minnesota contained one charcoal furnace, but it was not in operation in that year, and was abandoned in 1888. In the census year 1890 a large coke furnace was under construction in that State, but it was not completed until near the close of the year, and consequently had no product to report. California does not appear among the pig-iron producing States in either 1880 or 1890. A charcoal furnace was completed and put in operation in that State in 1881, but it has made no pig iron since 1886, and is practically abandoned.

The relative rank of the various States is seen from the following table, giving net tons of pig iron production by States for the census years 1880 and 1890, to have undergone many changes:

	1880.			1890.		
	STATES AND TERRITORIES.	Net tons.	Per cent. of total.	STATES.	Net tons.	Per cent. of total.
1.	Penna.	1,930,311	51.05	1 Penna.	4,712,511	49.19
2.	Ohio	548,712	14.51	2. Ohio	1,302,299	13.59
3.	N'w York	313,368	8.29	3. Alabama.	890,432	9.29
4.	N. Jersey	157,414	4.16	4 Illinois	674,506	7.04
5.	Michigan	119,586	3.16	5. N'w York	359,040	3.75
6.	W'consin	118,282	3 13	6. Virginia.	302,447	3.16
7.	Illinois	95,468	2.52	7. Tenn.	290,747	3.04
8.	Missouri	95,050	2.51	8. Mich.	224,908	2.35
9.	W. V'rg'a	80,050	2.12	9 Wis.	210,037	2.19
10.	Alabama	62,336	1.65	10. N Jersey	145,040	1.51
11.	Maryla'd	59,664	1.58	11. W. Va.	108,764	1.14
12.	K'ntucky	58,108	1 54	12. Missouri.	99,131	1.04
13.	Tennes'e	47,873	1.27	13. Maryla'd	96,246	1.00
14	Georgia.	23,099		14. Kentuc'y	44,199	
15.	Conn.	18,779		15. Georgia.	35,747	
16.	Indiana.	18,237		16. Conn.	21,700	
17.	Virginia.	17,906		17 Colorado.	12,949	
18.	Mass.	9,543	2.51	18 Indiana.	11,476	1.71
19.	Oregon.	3,200		19. Texas.	8,950	
20.	Maine	2,015		20. Oregon.	8,411	
21.	Texas.	1,400		21. Mass.	8,381	
22.	Vermont	620		22. Wash'tn.	4,787	
23.	Minn.	.....	.....	23. Maine.	3,700	
24.	N. Car'a.,	.....	.....	24. N. Car'a.	3,377	
25.	Utah	.....	.....	25. Minn	.....	.....
	Total.	3,781,021	100.00	Total	9,579,779	100.00

Notwithstanding the fact that the production of pig iron has increased from 3,781,021 net tons in 1880 to 9,579,779 tons in 1890, the total number of completed furnaces has decreased during the ten years from 681 to 562. Many furnaces which were in the active list in 1880 have since been abandoned, owing to their inability to profitably compete with the larger, better located, and more modern furnaces of the present day.

Since 1880 there have been 282 furnaces abandoned in the United States, owing either to unfavorable location to give place to larger and more modern plants, while during the same period 163 new furnaces have been built, in addition to a large number of plants that have been remodeled and new machinery added.

At the close of the census year 1890 the total number of blast furnaces which were active, or likely to be some day active, was 562, of which 169 were anthracite, or anthracite and coke furnaces, 253 coke and bituminous coal furnaces, and 140 charcoal furnaces. Of the total number of furnaces at the close of 1880, there were 229 anthracite, or anthracite and coke furnaces, 195 coke and bituminous coal furnaces, and 257 charcoal furnaces. In the decade from 1880 to 1890 there is seen to have been a decrease of 60 in the number of anthracite, or anthracite and coke furnaces, a decrease of 117 in the number of charcoal furnaces, and an increase of 58 in the number of coke and bituminous coal furnaces.

Of the 562 completed furnaces at the close of the census year 1890 there were 338 in blast, of which 110 were anthracite, or anthracite and coke furnaces, 165 coke and bituminous coal furnaces, and 63 charcoal furnaces. The number of furnaces building at the date mentioned was 39, of which 9 were in Virginia, 7 in Alabama, 5 in Pennsylvania, 4 in Illinois, 3 each in Kentucky, Tennessee and Michigan, 2 in Maryland, and 1 each in Georgia, Ohio and Wisconsin.

One of the most noticeable features in the growth of the manufacture of pig iron in this country during the past decade is the development of the blast furnace industry of the Southern States. The greatest activity in undertaking new furnace plants was in 1887, during which year 5 new furnaces were blown in and 25 others were under construction. There has been but little abatement in this activity to the present time. The following table

shows the production of pig iron in the Southern States during the census years 1880 and 1890 in net tons:

States.	1880. Tons.	1890. Tons.	Percentage of incr.	Percentage of decr.
Alabama	62,336	890,432	1,328.44	....
Georgia	23,099	35,747	54.76	....
Kentucky	58,108	44,199	.....	23.94
Maryland	69,664	90,246	61.31	....
North Carolina	.....	3,377	.....	....
Tennessee	47,873	290,747	507.33	....
Texas	1,400	8,950	539.29	....
Virginia	17,906	302,447	1,589.08	....
West Virginia	80,050	108,764	35.87	....
Total	350,436	1,780,909	408.20	....

In the six Western States which produced pig iron in the census years 1880 and 1890 there is also seen to have been a large increase in the production. The following table gives the quantity of pig iron, in net tons, made by each of these States in the years named:

States	(1880.) Tons.	(1890.) Tons.	Percentage of incr.	Percentage of decr.
Illinois	95,468	674,506	606.53	.....
Indiana	18,237	11,470	.....	37.11
Michigan	119,586	224,908	88.07	.....
Missouri	95,050	99,131	4.29	.....
Ohio	548,712	1,302,299	137.34	.....
Wisconsin	118,282	210,037	77.57	.....
Total	995,335	2,522,351	153.42	.....

The following table shows the production of pig iron in the United States, in net tons, in the census years 1880 and 1890, arranged according to the fuel used, with the percentage of increase or decrease in production in 1890:

Fuel used.	1880. Tons.	1890. Tons.	Percentage of incr.	Percentage of decr.
Anthracite alone	1,112,735	323,258	.....	70 95
Mixed anthracite coal and coke	713,932	1,879,098	163 20	....
Coke and bituminous coal	1,515,107	6,711,974	343.00	....
Charcoal	435,018	655,520	50.69	....
Castings direct from furnace	4,229	9,929	134.78	....
Total	3,781,021	9,579,779	153.36	....

The foregoing figures clearly exhibit the important part that bituminous coal and coke have taken in the growth of the pig-iron industry since 1880. The larger proportion of the production of pig iron credited to these fuels is made from coke alone. A few furnaces use raw bituminous coal only, and their production is included in the total for coke and bituminous coal. In the use of anthracite coal alone as a blast-furnace fuel there is seen to have been a marked decrease since 1880, while the production of pig iron with mixed anthracite coal and coke has more than doubled.

The remainder of the report relates to details of the production by States.

THE FAMOUS KINZUA VIADUCT, which carries the tracks of the New York, Lake Erie & Western R. R. over the gorge of Kinzua Creek, New York, will, it is stated, be removed; it not being heavy enough for the rapidly increasing traffic. The structure is 2,052 ft. long and 301 ft. high. It consists of 20 towers, each 10 ft. × 38½ ins. at the top and of varying widths at the bottom, the highest being 103 ft. × 38½ ft. at the base. The viaduct was designed to carry a load of 3,075 lbs. per lineal foot, and cost $237,000. It is not decided whether a heavier structure will be built to replace it or whether a detour will be made to avoid the gorge. The viaduct was designed by Mr. O. CHANUTE, then Chief Engineer of the Erie Railroad.

THE ST. CLAIR TUNNEL headings met Aug. 25, 100 ft. of the tunnel proper remaining to be completed. The long approaches to the tunnel, aggregating some 22,000 ft., remain to be completed, but are plain excavation work. The tunnel is the most important work of the kind in the world, and also the most successful.

THE TENNESSEE PASS TUNNEL on the Denver & Rio Grande, near Leadville, Col., was holed Aug. 22. The tunnel is 2,550 ft. in length, piercing the continental divide at an altitude of 10,000 ft. above sea level. The tunnel was begun last December and has been pushed from each end by three 8-hour shifts.

THE CHAIN OF ROCKS TUNNEL under the Mississippi River, for the St. Louis, Mo., waterworks, was advanced 295 ft. 10 ins. in the month of June, an average progress per day of 10 ft. 7 ins. The tunnel is 10 ft. in diameter and 2,300 ft. in length, of which the last 1,500 ft. are under the Mississippi River. It is driven through very hard limestone, and all excavated material has to be hoisted 90 ft. to the surface. The contractors, McCormick & O'Meara, are working two ten-hour shifts and using one 16 × 24 in. Ingersoll-Sergeant air compressor and five "E" Eclipse drills. The greatest progress made in any one day was 13 ft. 6 ins., on June 3.

THE NICARAGUA CANAL CONSTRUCTION CO. has purchased the plant of the American Contract & Dredging Co., at Panama, consisting of several dredges, lighters, tug boats, and repair plant, and is removing it to Greytown. The plant will be put at work dredging the harbor at Greytown.

THE CINCINNATI WATER-WORKS have been investigated by a committee appointed by the Cincinnati Commercial Club, and by Messrs. G. BOUSCAREN and CHAS. HERMANY, experts employed by that committee.

The engineers' report shows that the water actually lifted by the pumping engines is but 30,000,000 galls. per 24 hours, whereas the capacity at which they have been rated, after making all allowances for their known inefficient condition, was 56,000,000 galls. The engineers characterize the water-works plant as "an aggregation of pumping engines which defies the world to produce its parallel in blunders."

The committee's report states that the control of the water-works has been placed in the hands of a half dozen different boards and commissions since 1876, and its management has been wholly in the interest of politicians. Under the present system no substantial improvement is possible. The committee recommends the securing of legislation to place the water-works in the hands of a non-partisan commission with sufficient tenure of office and clothed with such power as will provide ways and means for the supervision and development that the water supply may require.

THE WATER POWER DAM to be built at Topeka, Kan., will be put under construction about Oct. 1. It will be built on a concrete base, faced with masonry to the water level, and from there up of masonry alone. It will be 771 ft. long; 29 ft. 4 ins. wide at the base; 6 ft. wide at the top; height at south side, 20 ft.; height at north side, 42 ft.; slope of up stream face, .0521 in. per ft.; curvature of down stream face, 17.1°. On the south side a flume of masonry 80 ft. wide and 200 ft. long will be constructed, in which will be placed the turbines. In the construction of the dam it is proposed to put in six buttresses which can be used as piers for a bridge if desired. The contracts for the masonry and electrical and water power machinery will be let soon.

AN IRRIGATION CONVENTION has just been held at Aberdeen, S. Dak., at which representatives from the two Dakotas were present. Resolutions were adopted in favor of both the canal and artesian well systems, and recommending the immediate sinking of wells in the James River Valley. A memorial for presentation to Congress was framed requesting government aid to irrigation.

THE AMOUNT OF PAVING IN NEW YORK CITY on June 30, 1890, was 8,277,623 sq. yds., of which 2,225,811 sq. yds. were specification granite; 673,402 sq. yds. block granite; 1,248.529 sq. yds. specification trap; 3,045,214 sq. yds. Belgian blocks; 101,643 sq. yds. cobblestone; 71,190 sq. yds. asphalt; 516 sq. yds. wood; 2,964 sq. yds. Russ; 908,354 sq. yds. macadam. There are 359.15 miles of paved streets within the city limits.

PAVING MATERIALS for large cities are classified according to their desirability by LOUIS WAGNER, Director of Public Works, Philadelphia, as follows: (1) Belgian blocks of good granite. (2) Sheet asphalt. (3) Vitrified brick. (4) Asphalt blocks. (5) Macadam or Telford. Mr. WAGNER says that classes 4 and 5 should not be used at all in Philadelphia, and that class 3 should be used only where there is little traffic, and that the joints should be filled with brick or paving cement. Regarding macadam or Telford paving, he says it "should be laid only in country districts, and not where it is expected to be the permanent pavement," for "it is always muddy in wet weather and dusty in dry weather; and unless it is regularly and carefully sprinkled and rolled it wears out more rapidly than any other kind."

A NEW METHOD OF STREET CLEANING has been recently tried in New York City. After the street was swept, a stream from a fire engine was applied to thoroughly wash the surface of the street. The results were not satisfactory from any point of view. The muddy water collected in puddles in the hollows of the paving, while the amount of sand and silt washed down the sewers threatened to soon choke them up, and also to so fill the ferry slips and docks into which they discharge as to require constant dredging. Good paving and efficient sweeping are evidently essential to clean streets.

ELECTRICAL HOISTING MACHINERY is said to be giving great satisfaction on the piers of the Prentice Stores, in Brooklyn, N. Y. The motors there employed are of the Crocker & Curtis type, of 10 HP. each, and automatically governed so that only enough current is used to lift the load on the ropes.

POWER FOR SMALL SHOPS IN GENEVA, Switzerland, is now partly furnished by turbines in the bed of the Rhone River. In 1883, Gen. TURRETTINI laid a plan before the Geneva authorities for utilizing the power of the Rhone. The river, as it passes through Geneva, is divided into two branches by an island. One branch was utilized as an outlet for the Lake of Geneva, while the bed of the second was carefully graded. A power house with room for 20 turbines of 4,400 total HP. was built and 10 turbines at once installed. Power is distributed by water through two sets of high-pressure pipes, as is done in Zurich. The practical result of the works is far beyond what the promoters anticipated; at the end of last year, there were 216 motors using 1,565 H.P. supplied in this way. The smallest of these was of ⅛ HP. for running sewing machines, and the largest supplied 625 HP. to an electric light plant. The total cost of the work has been $1,377,500. In 1887, the city received a net profit of $26,700 from the plant after deducting cost of maintenance, salaries and interest.

THE FLORIDA PHOSPHATE BEDS, like most newly-discovered mineral deposits, have been largely overestimated, according to a paper by FRANCIS WYATT in the *Engineering and Mining Journal*. Mr. WYATT has examined about 75,000 acres of phosphate lands scattered through 17 Florida counties, and while he finds that there are immense deposits of phosphatic material in the State, a large proportion of it is too low-grade material to be profitably worked. A good many fortunes have already been made in the land speculation which the phosphate finds have fostered, and a good many are likely to be lost when the boom collapses.

THE COAL-WASTE COMMISSION of Pennsylvania has issued a circular asking information on the followings points:

Geological and Statistical: Estimates of the original geological coal-field and waste of erosion; of the existing coal field before coal mining began; of the amount worked to the present year; of the total amount that it is possible to take from the earth by any known system of mining, giving the amount that must be left in the ground in shape of pillars, etc., or what may be regarded as permanent structural waste.

Waste of Producing and Marketing: Investigations of the underground waste of mining; of the waste of preparation, including all processes in which the commercial size has been continually reduced, the amount of culm in sight at place of preparation, and the annual product of culm; of the marketing of the pea, buckwheat, bird's-eye or rice, and dust, and the uses to which the several sizes or conditions are put.

Utilization of Coal-Waste: Examination of the whole Briquette system, duly recorded tests under responsible supervision, patent-office records, specimen forms, and chemical analyses. Accumulation of the record of all the practical mechanical appliances by which the waste is utilized without mechanical preparation, such as devices of furnaces, grates, blowers, etc., etc. Investigation of the use of waste after mechanical preparation for combustion, as in pulverized conditions, etc., etc. Examination of the gasifying processes into water and producer-gas, also in the destruction of garbage or cremating work, also in agricultural experimentation.

THE CHICKAMAUGA AND CHATTANOOGA NATIONAL MILITARY PARK has been established by the passage by Congress of the bill by that name. The park will be 12¾ sq. miles in area, and will include the battle fields of Chickamauga and Lookout Mountain. It is the intention to lay out about 67 miles of drives, and otherwise improve the grounds.

CONSTRUCTION NEWS.

RAILWAYS.

EAST OF CHICAGO—Existing Roads.

Portsmouth & Concord.—Arthur W. Dudley, of Exeter, N. H., Chief Engineer, writes as follows:

Surveys are now in progress for an extension from Greenland Depot, on the main line, via Stratham and Exter, to Epping Station, N. H., a distance of 13 miles. The road is being built to open up the towns along the route to the cities of Manchester and Portsmouth. The principal business will be in coal, with a large general freight and passenger business. The route is through a rolling country; maximum grade 52.8 ft. per mile; maximum curve 2°. Sufficient money has been raised to make the surveys, and subscriptions to the stock are now being secured. The enterprise is at present in the hands of a committee of the Board of Trade and citizens of Exeter.

Ohio & Mississippi.—The Cincinnati & Bedford Ry. running from a point on the main line about 4 miles east of Mitchell, Ind., to the Bedford quarries, has been opened for traffic. The line is 6 miles long, and will open up a large number of quarries.

Shore Line.—A press dispatch says:

Richard J. Cross, of New York, President of the Shore Line Ry. Co., of which Russell Sage is the largest owner; President Van Horne, of the Canadian Pacific, and other prominent officials of both companies, held a consultation at St. John, N. B. It is understood they are discussing the project of connecting the Canada Pacific and Shore Line systems by a branch from Mattawamkeag to Calais, Me., and that the Canada Pacific will buy Mr. Sage's line. This will give the larger road its own line from ocean to ocean, whereas it now runs over 5½ miles of the Maine Central.

Baltimore & Eastern Shore.—This road has been put in operation from Bay Side to Vienna, Md. Tracklaying is in progress between Vienna and Salisbury, and will be completed in a few days.

Baltimore & Ohio.—The bids for building the Baltimore Belt R. R. have all been received. There were 23 bidders. The contract will be awarded soon.

Midland (Indiana).—A press dispatch dated Aug. 19 says:

Thirty days ago the Midland R. R. commenced a 20 mile extension west to the Indiana coalfields in Park Co. The work was completed to-day and an excursion train will run over the road to-morrow to the coal mines.

Pennsylvania, Lehigh & Eastern.—Contracts will, it is stated, be let in a short time for the construction of this road from Tombicken to Stroudsburg, Pa. S. N. Haight, 111 Broadway, New York City, is Chief Engineer.

Projects and Surveys.

Davenport, Middleburg & Durham.—Residents of the Catskills interested in building a railway from the village of Catskill to Cooperstown, N. Y., via Middleburg, have formed a company by this name, with a capital of $600,000. A meeting was recently held at which it was stated that a survey had been made from East Davenport to East Durham, and that the right of way, with one or two exceptions, had been secured. Among those interested are: Judge Harris, of Cooperstown, and J. E. Young, J. H. Cornell and W. E. Thorne, of Middleburg.

North Canadian Atlantic Railway & Steamship Co.—Engineers will soon commence the survey of a railway from Quebec to St. Charles Bay on the Labrador coast, a distance of 850 miles. From the latter point a steamship line will run to Milford Haven, in Wales. The scheme also includes the building of a railway from Milford to London, Eng. Sir Hector Longevin, Minister of Public Works for the Dominion, is interested.

Perth Amboy & Long Branch.—This company has filed articles at Trenton, N. J., for a road to connect the Central R. R. of New Jersey, in Middlesex Co., with the New York & Long Branch R. R. at the north end of the Raritan River Bridge in the same county. The connection will be 6,000 ft. long. The incorporators are James N. Du Barry and Henry D. Welsh, of Philadelphia, and others.

Washington & Cumberland.—All the stock offered by this company has been taken. This road is projected to run along the towpath of the Chesapeake & Ohio Canal, paralleling the Baltimore & Ohio R. R. from the coal fields of Western Maryland and West Virginia to tidewater. The West Virginia Central R. R. is said to be behind the scheme. The stock offered was 2,000 shares. A meeting of stockholders will be held on Oct. 15 to elect directors and others.

Little Falls, Van Hornesville & Otsego Lake.—A meeting was recently held to devise a plan for carrying out this enterprise, and a committee has been appointed to solicit subscriptions. The road is projected to run from Little Falls to Richfield Springs, N. Y., 27 miles. S. E. Babcock, of Little Falls, N. Y., is Chief Engineer.

SOUTHERN—Existing Roads.

Louisville & Nashville.—Surveys are in progress for a 2-mile belt line at Florence, Ala.

Charleston, Sumter & Northern.—Pringle & Co., the contractors for the extension to Bennettsville, S. C., now have about 400 men at work, and are making good progress. The Phœnix Bridge Co. will build the 393-ft. bridge across the Pee Dee River, and Williams & Truly have the contract for the trestle across the Pee Dee swamp.

Columbia, Newberry & Laurens.—A further extension of this South Carolina road to Clinton, S. C., has been located. Chas. Ellis, Jr., of Columbia, S. C., is Chief Engineer.

Middle & East Tennessee.—J. C. Rodemer & Co., the contractors, have about 60 hands at work on the line from Gallatin to Hartsville, Tenn., and work is making good progress. Two miles have already been graded, and it is expected to have the entire line completed by Jan. 1, 1891.

East Shore Terminal.—Work on this belt railway at Charleston, S. C., is making good progress. Tracklaying has been commenced and the line is expected to be completed by Sept. 1.

Decatur, Chesapeake & New Orleans.—Work is making satisfactory progress on the section from Booneville to Shelbyville, Tenn. The road is to be completed to Shelbyville by Oct. 1. A report is in circulation that the line will be extended south from Decatur, Ala., to Columbus, Miss.

Seaboard Air Line.—Tracklaying on the Georgia, Carolina & Northern R. R. has been completed to Clinton, S. C., about 100 miles from Monroe, S. C., the present northern terminus of the road. Between Clinton and the Savannah River the grading is nearly completed and work is rapidly progressing on the bridges across the Savannah River and the intermediate streams. From Greenville toward Clinton 16 miles of track have been laid.

Atlantic Coast Line.—At a meeting of the stockholders of the Wilmington & Weldon R. R., recently held, it was voted to extend the Nashville Branch from Spring Hope to Raleigh or Durham, N. C. An increase of the capital stock was voted to provide funds for this purpose, and also for completing the Fayetteville Branch to the South Carolina State line and the Scotland Neck Branch to Washington, N. C.

Wilmington, Onslow & East Carolina.—Tracklaying has been completed from Wilmington to the Onslow Co. line, 22 miles west of Jacksonville, N. C. Work is being pushed on the line to Jacksonville, and preliminary surveys have been completed for a further extension from Jacksonville to Newbern, N. C., 40 miles.

Projects and Surveys.

Southeastern.—F. L. Cawley, of Cordele, Ga., writes as follows:

The surveys for this road, which is projected to run from Fort Valley to Cordele, Ga., and ultimately to Way Cross, Ga., will commence about Sept. 15. The route is through a thickly settled, rolling pine timber country, affording light work. About 40 miles of the right of way have been secured and other local aid amounting to $220,000 obtained. H. C. Bagley, of Anniston, Ga., is President.

Seneca Short Line.—The construction of a railway from Seneca, S. C., to a connection with the Georgia, Carolina & Northern R. R. is being talked of.

Carolina Southern.—The final location of this road has been completed, and construction will, it is stated, soon begin. The road is to run from Cheraw to Sumter, S. C., 65 miles. Wm. Moncure, of Durham, N. C., is Chief Engineer.

Georgetown & Charlotte.—It is rumored that the Georgetown & Charlotte R. R. Co., which was organized some years ago, is about to go to work and construct its line. Books of subscription have been opened in Charlotte.

Bedford City & Big Island.—Surveys are reported in progress on this Virginia railway.

NORTHWEST.—Existing Roads.

Milwaukee & Northern.—It is reported that this road will be sold to the Chicago, Milwaukee & St. Paul R. R. Co.

Canadian Pacific.—Tracklaying on the Glenboro branch has been stopped, the rails being laid to the Brandon branch of the Northern Pacific R. R., and no further work can be done until the Privy Council has given permission to make a crossing. Tracklaying, however, will be commenced at Plum Creek and pushed east to the crossing.

Northern Pacific.—A press dispatch says that this company will build a branch from Oakes, N. Dak., to Pierre, S. Dak.

Pacific Short Line.—The engineers have cross-sectioned a section of 20 miles west from O'Neill, Neb., and work will, it is stated, begin at once.

Winona & Southwestern.—The extension of this road is now graded and bridged from Utica to Stewartville, 33 miles, and tracklaying is in progress.

Chicago & Eastern Illinois.—The survey has been completed for the line from Tuscola to Shelbyville, Ill., 40 miles.

Projects and Surveys.

Lebanon, Mascoutah & Fayetteville.—Chartered in Illinois to build a railway from Lebanon to Mascoutah, Ill. The capital stock is $100,000.

SOUTHWEST.—Existing Roads.

St. Louis, Iron Mt. & Southern.—A preliminary survey is being made for a line to run from Monticello to Camden, Ark. The route will be through a fine timber growing section of the State.

Houston Belt & Magnolia Park.—About 100 men and 30 teams are now at work on this short Texas road. John F. Brady, of Houston, Tex., is President.

Weatherford, Mineral Wells & Northwestern.—At a recent meeting of the stockholders of this company, a resolution was passed authorizing the board of directors to execute a deed of trust to the Central Trust Co. of New York, being the trustee, for $500,000 on the roadbed, rolling stock, franchises, etc., on that part of the road now being built. In this transaction the former mortgage of $350,000 is to be taken up and canceled. Grading on the road is progressing nicely, more than half of the work of grading between Weatherford and the coal mines having been done. President Stone, of the road, says that tracklaying will begin about Sept. 15.

Kansas City, Watkins & Gulf.—A. Thomson, of Lake Charles, La., President, writes:

About 150 men and 80 teams are now at work on the division from Lake Charles to Alexandria, La. About 70 miles have been graded and 10½ miles of track laid, and it is expected to have the line completed by Jan. 1, 1891. Kennedy & Stone have the contract. The route is through a good farming and long-leaf yellow pine timber country. The grading is generally light and the curvature will not exceed 1° per mile. P. H. Philbrick, of Lake Charles, La., is Chief Engineer.

Shreveport Ry. & Land Improvement Co.—A. C. Hepburn, of Shreveport, La., Chief Engineer, writes as follows:

The grading has been completed and 5 miles of track have been laid on this belt road at Shreveport, La. The total length of the road will be 5½ miles. The earthwork will average about 20,000 cu. yds. per mile; maximum grade 6% and maximum curve 10°.

Mississippi & Little Rock.—Tracklaying has been commenced on the extension from Duncan to Little Rock, Ark., 61 miles.

Kansas City Suburban Belt.—A portion of this road has been opened for traffic. Work will be pushed on the remainder and it will be completed as rapidly as possible.

San Antonio & Aransas Pass.—Work has been resumed on the line from Cameron to Lexington, Tex.

Projects and Surveys.

Bayou Lafourche Central.—Joseph Maille, of 166 Common St., New Orleans, La., President, writes as follows:

This road is projected to run from St. James to Napoleonville, La., and thence to Lake Verret, a distance of 20 miles. Surveys will begin about Oct. 1. The principal business of the road will be in lumber and sugar.

Warren & Arkadelphia.—Efforts are being made by the citizens of Warren, Ark., to secure the construction of a line of railway from that place to a connection with the St. Louis, Arkansas & Texas Ry.

Victoria & Rockport.—Surveys are being made for a railway from Victoria to Rockport, Tex.

ROCKY MT. AND PACIFIC.—Existing Roads.

Washington.—The item under this title, published in our issue of Aug. 16 was, during the absence of the editor of these columns, inadvertently credited to a Port Townsend paper instead of to the *Railroad Gazette* from which the former paper copied it.

Oregon & Washington Territory.—Grading has been discontinued on the extension from Union to Elgin, Ore., 23 miles, on account of difficulty in obtaining right of way.

Great Falls & Canada.—Tracklaying has been completed on this road from Great Falls, Mont., to the International boundary, 133 miles. On the Alberta Coal & Ry. Co.'s line from the International boundary to Leithbridge, N. W. T., construction is now in progress and track is being laid at the rate of 3 miles per day. It is expected to have the line completed by the middle of September.

Seattle, Lake Shore & Eastern.—Bridge building is the principal work being done on the northern extension of this road. Work on the Pilchuck bridge is now beginning and will be finished in about 2 weeks. Considerable trestling is also to be done between the Pilchuck and the Skagit rivers. Work is also beginning on the Skagit bridge at Sedro, and it will be finished far enough for material to cross in three weeks. Tracklaying will then be pushed in three directions, from Arlington north across the Pilchuck, from the Skagit river south, and from the Skagit north to the Nooksack. By Oct. 1 track will be laid and trains running to Sedro, and track will be laid north to the south fork of the Nooksack. Work can then begin on the bridges over the two forks of the Nooksack. Mr. M. J. Heaney, who has the contract for the grading of 20 miles, extending south from Nooksack City, has 175 men at work, and will finish his contract ready for the rails by Sept. 10. Ten miles are now completed. The 15 miles immediately south of this 20 will be done by Oct. 1. Work is going ahead also north of his contract, toward the border. Work on the Canadian Pacific branch to the boundary has been delayed by high water, and the contracts for grading were only let a few days ago. For the same reason work on the Mission Bridge progresses slowly, and it will not be ready to cross before Nov. 1. It is probable that connection at the boundary will be made about Jan 1.

California & Nevada.—It is stated that work has been resumed on the extension from San Pablo to Bodie, Cal.

Bellingham Bay & British Columbia.—Bids are asked for constructing the extension from the Nooksack River to the International boundary, 8 miles. M. L. Stangroom, of New Whatcom, Wash., is Chief Engineer.

Union Pacific.—Additional forces are being added to the construction force at work on the Portland & Puget Sound R. R. The work will be quite heavy in many places, there being a large amount of trestling and bridge work.—Surveys are in progress for a line from Kalama,

Wash., along the Lewis River, a distance of 35 miles. The road will open up a rich coal, iron and timber country.

Northern Pacific.—W. S. Mellen, General Manager, is reported as saying that about $1,000,000 will be spent by the company this year for steel rails to replace the old rails between St. Paul and Tacoma, and also on the Portland, division between Tacoma and Portland. Mr. Mellen says:

"We are renewing old wooden bridges with stone culverts; we are putting in many stone and iron bridges and expending in all between $4,000,000 and $5,000,000 for the betterment of our line. The snowshed system is being substantially added to by a number of new structures, as well as additions and repairs to the old ones. We have just closed the contract for a rotary snow shovel, with all the recent improvements, at a cost of $17,000."—About 2,000 men are now at work on the line from Missoula, Mont., to Mullan, Idaho.—On the Yakima & Pacific Coast R. R. the engineers have completed the location from Chehalis to South Bend and are now at work cross sectioning the line. Construction is in progress with a force of about 175 men near Chehalis and 3 miles of track have been laid. There is a great scarcity of laborers. Two corps of engineers are surveying the line east of Chehalis to North Yakima.—About 500 men are at work on the extension from Durham to Niblock's mine. This line will be completed by Jan. 1.

Great Northern.—Tracklaying is progressing at the rate of 1½ miles per day on the Fairhaven & Southern extension to the International boundary.—The right-of way is being rapidly procured for the Seattle & Montana R.R. from Fairhaven, Wash., to Portland, Ore.—Woolly & Co., of Woolly, Skagit Co., Wash., have been awarded the entire contract for sawed and hewn ties for the Seattle & Montana Ry., and are ready to receive bids and let contracts in lots from 500 to 25,000 along the line of Seattle & Montana from Woolly to Seattle, or along the line of the Seattle & Northern R. R. from Woolly to Hamilton, or on the Fairhaven & Southern R. R.

Projects and Surveys.

San de Fuca & Northwestern.—The route of this proposed railway is through Oak Harbor, San de Fuca, La Conner, Mt. Vernon and Sedro, up the north bank of the Skagit River, and connecting with the Fairhaven & Southern and the Seattle, Lake Shore & Eastern railways at Sedro, Wash. Applications for subsidies have been made to several of the towns on the route, and have been favorably received. The route is 39.7 miles long.

Portland, Salem & Astoria.—Chartered in Oregon to construct lines of railway from Portland to Astoria and Salem, Ore., and to secure control of the Astoria & South Coast R. R., now under construction from Astoria, Ore., south.

Coos Bay, Roxburg & Eastern.—Chartered in Oregon with the following officers: President, T. W. Sheridan; Vice-President, F. W. Burnett; Secretary and Treasurer, W. E. Barns, and General Manager, R. A. Graham. The contract is reported let for the entire road from Marshfield, Coos Co., to Roseburg, Douglass Co., to R. A. Graham, who is to commence work at once.

San Francisco & Stockton.—Chartered in California to build a railway from a point at tide water on the bay of San Francisco, through Alameda, Contra Costa and San Joaquin counties to a point near the city of Stockton. The length of the railway is to be 75 miles.

Gold Belt & Western.—Organized in Idaho to build a railway from Hailey to Junction Bar, on the South Boise River. Surveys will commence at once.

Frankfort, Pacific & Eastern.—The object of this company, noted as incorporated in our last issue, is to build a broad gauge railway line from Frankfort, Wash., west to the shore of the Pacific Ocean, in Pacific County; another line northwest from Frankfort to Spokane Falls, Wash.; also a line from Frankfort, or some point on the main line, north to Port Townsend, Wash. Among the incorporators are: Hon. A. J. Steele, of Helena, Mont.; Judge C. S. Fogg, of Tacoma, and Capt. J. H. D. Gray, of Astoria Ore.

White River.—Incorporated in Washington to build lines of Railway from Buckley, Wash., west to Tacoma and southwest to the Columbia River, with branch lines. The incorporators are: E. M. Goss, Chas. W. Joynt and Geo. A Mitchell.

FOREIGN.

Brazil.—A railway is to be built from Itarare to St. Maria da Bocca do Monte, a distance or 620 miles. There will also be two branch lines, the first from Imbituva to the frontier of Paraguay, and connecting by two loop lines the navigable portions of the Upper and Lower Parana; the second from Cruz Alta to the frontier of the Argentine Republic. The length of these branches is estimated at 368 miles and 121 miles.

Jamaica.—A press dispatch says: Frank Wesson and E. L. Frank, of New York, and J. C. Easton, of Lacrosse, Wis., head the syndicate which recently took charge of the Jamaica R. R. Mr. Easton is home for a brief visit, and speaks highly of the prospects of the road. The government has made a complete survey of the Island, and located a line from Kingston to Montego Bay, with a branch to Port Antonio. The American syndicate's proposition was accepted by the government, after submission to the vote of the people. The price was $3,500,000, of which $1,000,000 was paid, and the balance is in income bonds. The syndicate organized as the West India Improvement Co. The contract provided that not less than 12½ miles should be built every year, which would complete the entire line in 12 years, making a total length, including the 65 miles in operation, of 215 miles. A grant of one square mile of land for every mile of road was made. This land, Mr. Easton says, is not what it has been represented to be. Much of it is wild and mountainous or volcanic. There are tracts in the Blue Mountains and probably some islands that will be valuable, but, on the whole, there is nothing to warrant any great expectation from the lands. R. B. Campbell, formerly Superintendent of the St. Paul Company's Council Bluffs division, is General Manager, and his assistants are principally from this country. All supplies and construction material come from the United States, except rails, while American rolling stock will soon supplant that which the syndicate took with the property.

Mexican & Central America.—The surveys are in progress for this road from the National Tehuantepec Ry. to the Guatemalan frontier.

CITY TRANSIT.

Dummy Railway.—*Jellico, Tenn.*—The Jellico Terminal Street Ry. will begin at once the construction of its line to Newcomb, a distance of 5 miles.

Elevated Railway.—*Brooklyn, N. Y.*—The commissioners appointed to report on the advisability of building an elevated railway on Atlantic Ave., recommend the immediate construction of a double track line between the Union Ferry and Flatbush Ave. and a triple track beyond that point. The structure is to be of sufficient strength to carry 35 ton engines from the ferry to the Jamaica station, and from that point east it will carry the regular locomotives of the Long Island R. R.

Electric Railways.—*Extensions* will be made at Washington, D. C.; Atlanta, Ga.; Galveston, Tex.; Santa Clara, Cal.

Knoxville, Tenn.—Surveys for a new line have been made by H. G. Bishop.

Davenport, Ill.—The Thomson-Houston Co. have contracted with C. B. Holmes of Chicago to build an electric line here, in Rock Island and Moline, Ill. The amount of the contract is $330,000.

Belleville, Ill.—The preliminary surveys for the Belleville & St. Louis Electric Ry. are now completed and construction will begin as soon as the right of way is secured.

San Antonio, Tex.—The South Heights Rapid Transit Street Railway Co. will build a line 2½ miles long.

Ogden, Utah.—The Ogden Rapid Transit Co. in which J. H. Meinhart, of Denver, is the leading stockholder, will lay about 10 miles of track before Jan. 1.

Helena, Mont.—Two new franchises were recently given; one to the Helena Electric Railway and the other to P. Winne.

Oakland, Cal.—J. W. Coleman, W. D. English and others will build a line from West to East Oakland.

Paso Robles, Cal.—J. T. Dunn and T. Haveland, of San Francisco, and G. R. Adams, of Paso Robles, will build a two-mile line.

Portland, Ore.—The Willamette Bridge Co. has bought 17 miles of horse railway here, and will at once introduce electricity.

New Companies.—Gardiner & Randolph R. R. Co., Gardiner, Me.; G. M. Hazelton, Sec'y. —South Lake & Germantown Ry. Co., Savannah, Ga. — Collin wood & Cleveland Street Ry. Co., Cleveland, O.; capital stock, $25,000; incorporators, T. K. Dissette, M. W. Cope and others.—Du Quoin, Ill., Street Ry. Co.; capital stock, $10,000; incorporators, H. Horn, P. N. Pope and P. D. Mifflin. — Boise City, Idaho, Rapid Transit Co.; capital stock, $20,000.—Wallace & Sunset R. R. Co., Wallace, Idaho; capital stock, $500,000.

BRIDGES, TUNNELS AND CANALS.

Bridges.—*Boston, Mass.*—The Pittsburg Bridge Co. has the contract for the Federal St. bridge at $10,218.

Bridgeport, Conn.—The commissioners of Fairfield Co., Conn., have been authorized to build in conjunction with the commissioners of New Haven Co., Conn., a bridge across the Housatonic River between the towns of Huntington and Derby. They were authorized to borrow $35,000 to aid in the cost of construction. The bridge will be of iron or steel and will cost about $70,000.

Mercer Co., N. J.—The Board of Freeholders will erect an iron bridge over a stream in Ewing township.

Pittsburg, Pa.—The plans for the new bridge across Sixth St. have been approved. It will cost about $500,000.

Baltimore, Md.—The construction of a bridge, 2,000 ft. long, over Druid Lake, in Druid Hill Park, is proposed. The mayor can give information.

Norfolk, Va.—The Norfolk Co. will build a bridge over De Brees Creek.

Richmond, Va.—Contract has been awarded to the Edge Moor Bridge Works for building an iron and steel viaduct, 1,200 ft. long and 40 ft. wide, connecting the properties of the Highland Park & Northside land companies with Richmond.

Virginia Midland R. R.—This company will construct a bridge over the Shenandoah River.

Georgia.—The East Tennessee, Virginia & Georgia R. R. will change into a draw its bridge 9 miles below Macon. The material for the work has already been laid at the bridge. The Covington & Macon R. R. will change its bridge at Macon into a draw by plans furnished to it by Engineer Carter. To change these bridges into draws will cost from $10,000 to $12,000 each.

Montgomery, Ala.—The Vermont Construction Co. has the contract for the bridge across Calonia Creek for $4,500.

Middlesborough, Ky.—A 70-ft. span iron bridge will be built across the canal on Cumberland ave., B. D. Lloyd, City Engineer.

Paris, Ky.—Bids are being received for an iron bridge to cost $5 000.

Nashville, Chattanooga & St. Louis R. R. This company is to build six new iron bridges on its road to replace the present structures. The new bridges are put in to prepare the road for the use of heavier engines.

Duluth, Minn.—Steps are to be taken soon to construct a viaduct over the railroad tracks at Lake Ave. The St. Paul & Duluth R. R. has offered to build the bridge if the city will settle any damages claimed by property owners, and this offer may be accepted.

Marble Falls, Tex.—The citizens are inviting plans from bridgemen to construct a bridge 650 ft. long and 50 ft. high across the Colorado river. The bridge will be built by a joint stock company.

Aberdeen, Wash.—Plans are being prepared for a drawbridge over the Wishka River at this place.

Tunnels. Mayor Sol White, of Windsor, Ont., is quoted as authority for the statement that a wagon and passenger tunnel will be built under the Black River at Port Huron, and from a point in Port Huron to be determined upon, to the Canadian shore at Sarnia. The principal stockholders will be Mayor Kenney and W. H. Anderson, of Port Huron, and Mayor White.

Surveys are in progress under the direction of Chief Engineer Wm. Hood, of the Southern Pacific R. R., for a tunnel through the Siskiyou Mountains. It will be about 5 miles long.

The headings in the Tennessee Pass tunnel on the Denver & Rio Grande R. R. met this week. The tunnel is 2,550 ft. long

WATER-WORKS.

NEW ENGLAND.

Portland, Me.—The company has ordered special castings, pipe and gates, and is about to introduce two cross-overs at Libby's Corner from the 20 in. to the 24-in. main.

Lewiston, Me.—There is talk of purchasing the Pincoln mill property to secure additional water power for the city. If this plan is carried out an additional pumping station for the city water-works will be built.

Meriden, N. H.—A water company has been organized for the purpose of bringing water into town from a spring on the farm of D. R. Wheeler.

Conway, N. H.—The contract for building works has been awarded to Franklin A. Snow, of Providence, R. I.

Middlebury, Vt.—The town has voted to issue $30,000 of bonds for constructing works. Lang, Goodhue & Co., Burlington, Vt., have made a proposition to put in works for $36,000. The following is from Harry L. Sheldon, Village Clerk:

The works will be built by the town. Estimated cost, $36,000; to be raised by village bonds. A. A. Fletcher is Chairman of the Committee appointed to make contracts, which will be let immediately. Water will probably be supplied by gravity from Otter Creek. Population, 1,800.

East Providence, R. I.—The members of the Water Committee appointed to entertain propositions for putting in pipes not now supplied with water are: E. C. Dubois, G. J. Norton and A. Cunningham.

Meriden, Conn.—The proposed plan for increasing the supply is to arrange to pump water in o the Pratt St. main from Pratt's Pond. The exact location from which the water will be taken has not yet been definitely decided. Pipes will be laid to connect with the Pratt main.

MIDDLE.

Roxbury, N. Y.—The following has been received from J. E. Newkirk:

Works are to be established by the Roxbury Village Water Co. President, C. J. Keator; Secretary, J. R. Dart B. B. Bouton, Roxbury, is the contractor. A. H. Todd, Griffins Corners, N. Y., is the engineer in charge of surveys. Water will be furnished by gravity from wells. Estimated cost. $20,000. Population, about 500.

Amsterdam, N. Y.—Water from Chuctanunda Creek has been turned into the reservoir and is now flowing at the rate of 1,250,000 galls. daily. About 1,000,000 galls. daily are running from the Perth creek. The daily consumption is 1,500,000 galls.

Johnstown, N. Y.—It is probable that a new reservoir will be constructed.

Franklinville, N. Y.—We have received the following information from Alfred Spring:

Contracts for the new works will probably be let on Sept. 4. They are to be built by the town. Estimated cost, $30,000 to $32,000, to be procured by bonds. The supply will be furnished by gravity from springs. Members of the Water Board are: President, A. O. Holmes; Secretary, A. Spring; Treasurer, S. A. Spring; Engineer in charge of surveys, E. A. Curtis, Fredonia, N. Y. Population, 1,100.

Watkins, N. Y.—The contract between the village and Contractor Charles Brown, of Mohawk, N. Y., for the construction of the new works, has been signed. It provides that the work shall be completed before Nov. 1.

Rochester, N. Y.—A resolution has been passed directing Chief Engineer Rafter to make the various improvements to the conduit line and repairs to the Rush reservoir gates and Hemlock Lake, as recommended in the report subm itted on Aug. 18. A considerable amount of new supplies will probably be purchased.

Long Island City, N. Y.—Sealed proposals for the purchase of any part of $15,000 of 5% water bonds will be received until Aug. 30 by F. W. Bleckwenn, Treasurer of Long Island City.

Millburn, N. J.—A movement is on foot to obtain a supply of water for the village from the Commonwealth

Water Co., of Summit. The County Road Board has decided to give the company permission to lay its pipes through the village to South Orange under certain restrictions. The company agrees to lay the pipes 4 ft. beneath the surface on Springfield avenue and to replace the road in good condition.

Short Hills, N. J.—The town has made a two years' contract with a company for a water supply.

Orange, N. J.—The Water Committee will make a report at the next meeting of the City Council on the best plan for increasing and improving the water supply.

South Orange, Millburn & Short Hills, N. J.—A late report states that these towns are to be supplied with water by the Commonwealth Water Co., of Newark, N. J. The work to be done under the supervision of Carroll Ph. Bassett.

Freehold, N. J.—Town Clerk C. H. Butcher has sent us the following information:

The town has voted to put in works. Information can be obtained from John Enright.

Pittsburgh, Pa.—It is proposed to sink a number of wells in the Twenty-sixth ward to secure water for domestic use.

SOUTHERN.

Radford, Va.—The new works will be operated by the Radford Water & Light Co. President, R. P. Chew; Secretary, G. E. Cassel. Capital Stock, $150,000.

Oxford, N. C.—H. C. Herndon is reported as stating that a "contract for the erection of works will be let as soon as reliable parties can be found." Another report states that a vote will be taken on Sept. 8, on the question of issuing $50,000 of bonds.

Columbia, S. C.—About $25,000 will probably be expended for putting in new pumps and water-wheels.

West Point, Ga.—The following is from H. T. Woodyard, Clerk:

The Town Council has been discussing the question of water supply for some time, but it has not been decided to put in a system

Atlanta, Ga.—A new system of water supply is to be established. The bonds have been disposed of by the finance committee at par, but have not yet been issued.

Milledgeville, Ga.—The Moran Springs property has been sold for $5,000 to parties who will construct works to cost $100,000.

Eustis, Fla.—Mayor P. A. Ross has been appointed Chairman, and H. W. Bishop, Secretary, of a committee to raise $20,000 for bringing water from Lake Joanna and Loch Levens to irrigate lands around Eustis, as well as for fire protection and domestic supply. The estimated cost of the completed works is $40,000. The committee appointed to report upon the plans proposed at present are: A. D. Wright, C. E.; E. L. Farren and H. W. O. Margary.

Sheffield, Ala.—Preliminary steps toward permanent city water-works have been taken by engaging Engineers Johnson and Flad, of St. Louis, to make the preliminary surveys.

Troy, Ala.—A well will probably be sunk by the Troy Water Supply Co.

Winchester, Ky.—It is reported that works costing $10,000 will be constructed by C. L. Hogan & Co.

Knoxville, Tenn.—The underwriters have addressed the City Council upon the subject of a better water supply. The company has ordered two new pumps with double the capacity of those in present use. Citizens will demand hereafter that the company shall, at least to some degree, filter the water furnished them.

Newport, Ky.—C. L. Jungerman, City Engineer, has sent the following:

The repairs and reconstruction of the reservoirs will consist of the removal of a large deposit of mud, the repair of a slip or slips in the embankment, and in general the bringing of the embankments to a true slope, and the repairing of the slopes and the cementing of the bottom of the reservoir. A system of flushing hydrants to aid in cleaning the reservoir will be introduced. Basin No. 1 will first be repaired, at a probable cost of $27,000.

The reservoirs were built in 1872-3. The paving was of an inferior character, and several years ago it slipped on one of the embankments, rendering it unsafe to empty the reservoir for cleaning, and preventing the reservoir from being filled to its full capacity.

Specifications for this work have been completed, and bids will be received until Sept. 8.

Louisville, Ky.—The estimated cost of the new standpipe is $20,000. The contract for the iron work has not been let. The new 48-in. main will probably be laid through Kentucky St.—S. J. Hobbs, it is stated, can furnish information concerning the Domestic Water Co., recently incorporated to construct works.

NORTH CENTRAL.

Kokomo, Ind.—H. M. Payson & Co., Portland, Me., are offering $7,000 of 6% bonds for sale.

Coldwater, Mich.—Attention is called to the contracts to be let here Sept. 16, as set forth in detail in our advertising pages. The works will probably consist of a brick-walled supply well, 30 ft. in diameter and depth, two 1,500,000 pumping engines, two steel boilers, and about 13 miles, or some 1,350 tons of 16 to 4 in. cast-iron, and 30 tons of special castings. J. D. Cook, Toledo, O., is Consulting Engineer for the city, and F. E. Morgan Secretary of the Water Committee.

Belleville, Ill.—Two reservoirs have been completed at the County Farm. The receiving reservoir is 150 by 250 ft. with a depth of 6 ft., and the filtering reservoir 90 by 135 ft. with a depth of 8 ft.

Chicago, Ill.—It is proposed to increase the water supply of the Town of Lake by constructing a tunnel from the lake.

Kenilworth, Ill. (a suburb of Evanston, Ill.)—George C. Morgan, Chicago, Ill., has sent us the following:

The new works were put in by the Kenilworth Water Co. George C. Morgan was the contractor and engineer. Estimated cost, $20,000 to $25,000. Water is conveyed from Lake Michigan to a Morgan special water tower.

NORTHWESTERN.

Creston, Ia.—A new company, with a capital of $30,000, has been organized to complete the new works.

Burlington, Ia.—A petition to compel the company to furnish the city with filtered water has been filed with the District Court. The water has been pumped directly from the river and is claimed to be unfit for drinking purposes.

Hampton, Ia.—We have received the following:

Plans for a system of works are being prepared by Civil Engineer George W. Wynn, of Cedar Rapids, Ia. Estimated cost, $14,000. Work will be done by the city under the direction of Mr. Wynn. It is proposed to complete them this season.

St. Paul, Minn.—Sealed proposals will be received until Sept. 22 for furnishing a 6,000,000-gall pumping engine in accordance with plans and specifications now on file. Address John Caulfield, Secretary Board of Water Commissioners.

O'Neill, Neb.—Fairbanks, Morse & Co., of Chicago, have been awarded the contract to furnish the materials and build the new works.

Hebron, Neb.—A system of works will probably be established. Address the Town Clerk

Chamberlain, S. Dak.—An election is to be held to pass upon the question of issuing bonds for sinking an artesian well for city purposes. At present the water is pumped from the river into a reservoir, but the expense is so great that the outlay for one year will put down the well. The present system of mains will be used.

White Sulphur Springs, Mont.—The citizens propose to organize a water company, with a capital stock of $100,000, for the purpose of supplying the town with a system of works.

SOUTHWESTERN.

Webster Groves, Mo.—Citizens have formed a company for the purpose of supplying this town and vicinity with water. They will commence boring for artesian water. H. W. Carter has charge of the undertaking. They expect to bore 500 ft., and have a working capital of $2,500.

Morrilton, Ark.—We have received the following from J. P. Jones, City Clerk:

Contracts will be let in October. The works will be built by a private company. A charter has been granted to W. E. Delaney, W. J. Showers, M. D. Shelby and E. D. Henry. Address E. D. Henry, Secretary, for information. The proposed plan is to pump water from the Arkansas River to a stand-pipe. Population, 2,100.

Hempstead, Tex.—A system of water supply is to be established. A well is to be sunk in the public square, and the water conveyed to a stand-pipe. The members of the committee are: C. C. Amsler, J. A. Felker and J. A. Peebles.

Comanche, Tex.—Address J. F. McCarthy for information regarding projected works.

Fort Worth, Tex.—A good flow of water has been struck at a depth of 1,100 feet.

San Antonio, Tex.—Col. Breckenridge has offered to sell the existing works to the city at $2,0.0,000. An election has been called to vote upon the question.

Dublin, Tex.—We have received the following from Whitehead and Stancil:

No contracts have yet been let, except for sinking the artesian well. If the well is not successful, deep well pumps will be put in. Whitehead and Stancil have been granted a 30 years' franchise. Estimated costs, $12,000. Population, 2,500. The well is being sunk by S. S. Gifford.

Yoakum, Tex.—Sealed bids will be received up to Sept. 20 for sinking an artesian well to furnish not less than 200,000 galls. of water daily. Bids to be of two kinds. Address M. G. Ranney, City Secretary.

Galveston, Tex.—Sealed proposals will be received until Sept. 25 for boring an artesian well to a depth of 3,000 ft., unless satisfactory water is procured at a lesser depth. Bidders to give price per foot for finishing with 6 in., 8 in., 10 in. and 12 in. pipes respectively. Address T. W. Jackson, Chairman Special Committee.

Cuero, Tex.—Extensions are being made.

Del Norte, Col.—The water-works project is still being considered.

PACIFIC.

Cheney, Wash.—The new works are being constructed by John Corkish, of Portland, Ore. Bonds for $40,000 have been sold to the Security Savings & Trust Co., of Portland.

Colfax, Wash.—The second artesian well is furnishing a good supply of water. A complete system of works will probably be put in.

Ellensburg, Wash.—Bids will be received until Sept. 10 for boring an artesian well to a depth of 1,500 ft., by J. R. Wallace, City Clerk.

Seattle, Wash.—The proposition of N. W. Harris & Co., of Chicago, Ill., to purchase $955,000 of 5% bonds has been accepted by the City Council.

Shelton, Wash.—The city has voted to expend $7,500 for securing a gravity water supply from springs.

The Dalles, Ore.—An engineer is now at work on the reservoir and the pipe line, and as soon as plans are completed bids will be advertised for and operations commenced.

Oregon City, Ore.—A new pump has been purchased. Extensions are to be made to the mains.

San Diego, Cal.—A vote will be taken on Oct. 8 on the question of issuing bonds for putting in a new system of works.

Santa Ana, Cal.—The city has voted to issue $60,000 of bonds, and to build and operate its own works.

Los Angeles, Cal.—Next year the water company proposes to erect another reservoir 180 ft. above the present reservoir, into which water will be pumped. The company has just completed extensive improvements to its plant.

CANADA.

Montreal, P. Q.—Sealed proposals will be received by Superintendent B. D McConnell for about 160 tons of special castings, 75 double-nozzle hydrants, etc., until Sept. 2.

Toronto, Ont.—To provide the necessary funds for the present proposed improvements it is recommended that the by-law recently rejected by the people, providing $200,000 for improvements, be re-submitted, and that two new engines and an engine house be provided.

ARTESIAN WELLS.

Barnesville, Ga.—It is proposed to sink a well. For information address McMichael & Hardy.

Alvarado, Tex.—Bids for sinking a well are wanted by J. A. Russell, Mayor.

IRRIGATION.

Denver, Col.—The Downing-Kountze Lateral Ditch Co. has filed articles of incorporation. The incorporators are: J. Downing, C. B. Kountze and S. Smith. The company will operate its ditch in Jefferson Co. Water will be taken from the Golden Ditch & Flume Co., range 69 west. Capital stock $2,000.

S. Dakota.—A press report states:

One thousand artesian wells will be sunk in S. Dakota for irrigation purposes before Jan. 1, 1891.

Pasco, Wash.—The Pasco Irrigation District has been formed. It is proposed to take water from the Snake River, elevating it 110 ft. into a canal, by means of steam pumps, to be located 3 miles from Pasco. The directors have advertised for bids for the plant and for construc. ting the canal and also for the sale of bonds to the amount of $110,000.

Modesto, Cal.—The Modesto and Turlock Irrigation Directors have decided jointly to build a dam, 90 ft. high, in the Tuolumne River, 1,800 ft. above the Wheaton dam, for the use of both districts. The litigation with M. A. Wheaton was compromised by the payment of $35,000, the Turlock District paying $32,500, and the Modesto District $2,500. The engineers of each district will submit plans for a masonry dam, the best plan to be accepted by the boards in joint session.

Helena, Mont.—Articles of incorporation of the Eureka Reservoir Canal and Irrigation Co. have been filed. Capital stock, $200,000. The incorporators have elected Z. T Burton President, J. P. Bousoaren Vice-President, W. M. G. Settles Secretary, and C. W. Burton Treasurer.

Baker City, Ore.—A company has been organized to build a dam across the river above the city to store water for irrigating and other purposes. It is to be over 100 ft. high and to form a reservoir one mile wide by 3 miles long.

SEWERAGE AND MUNICIPAL.

Sewers have been ordered at Troy, N. Y.; Newark, N. J.; Allegheny, Pa.; Columbus, O.; St. Paul, Minn.; St. Louis and Kansas City, Mo.; Los Angeles, Cal.

Buffalo, N. Y.—Assessment rolls amounting to $13,160 for 4¼ ft. brick and 18, 15 and 12 in. pipe sewers have been prepared.

Williamsport, Pa.—Carroll P. Bassett, M. Am. Soc. C. E., has prepared plans for the complete sewerage of the city, calling for an expenditure of $306,350 for sanitary and $401,460 for storm sewers.

Columbus, Ga.—The city will begin work on its system early in the fall. Its cost is estimated at $100,000. Mayor D. P. Dozier can give information.

Key West, Fla.—Bids for constructing the system at this place will not be opened until Oct. 1.

Salt Lake City, Utah.—Assessments for a number of sewers have been made.

Grading has been ordered at Allegheny and Wilkinsburg, Pa.; St. Louis and Kansas City, Mo.; St. Paul and Duluth, Minn. (estimated cost at last place, $35,200); Los Angeles, Cal.

Paving has been ordered at London, Ont. (cedar block, costing $14,500); Allegheny and Braddock, Pa.; Louisville, Ky., macadamizing; Columbus, O.; Kansas City and St. Louis, Mo.; St. Paul and Duluth, Minn. (estimated cost at last place, $27,800).

Montreal, P. Q.—The Roads Committee have recommended an appropriation of $26,120 for wood pavements, $13,622 for rock asphalt pavements and $11,343 for grading.

Buffalo, N. Y.—Assessment rolls far $36,000 of Trinidad asphalt, $12,880 of German rock asphalt, and $15,800 of macadam have been prepared.

Rochester, N. Y.—The Warren Scharf Co., have a $31,100 contract for asphalt, and Whitmore, Rauber & Vicinus, a $25,100 contract for Medina sandstone paving.

Columbus, O.—Asphalt, stone block, Hayden or Hallwood block, or brick, will be laid on several streets.

Bonds.—*Salem, N. C.*—The city will probably issue $50,000 of paving bonds. Mayor H. E Ives can give information.

Monroe, N. C.—An election will be held to decide upon the issuance of $25,000 of bonds to improve streets and erect an electric light plant.

Columbus, O., will issue $50,000 of street bonds.

ELECTRICAL.

Electric Light.—*Richmond, Va.*—An electric light and power plant will be erected at an early date, by Warner Moore and others.

Petersburg, Va.—T. Pannill will probably buy a plant.

Anderson, S. C.—The Anderson Hotel Co., will put in a 200 light incandescent plant.

Selma, Ala.—The Selma Electric Light & Gas Co., will purchase an incandescent plant.

Water Valley, Miss.—A vote will be held Sept. 29, on issuing $10,000 of bonds for an electric light plant.

Nashville, Tenn.—The Belmont Park Co., is reported as a probable purchaser of a plant.

Winchester, Tenn.—G. L. Hogan & Co. will build a lighting station costing $10,000.

Paxton, Ill.—The City Council has granted a 25-year franchise to C. H. Langford.

Omaha, Neb.—The electric Light Co. will make extensive additions to their buildings.

Dallas, Tex.—The Dallas Ice Factory will buy a plant, also a 50-ton ice machine.

Santa Fe, N. M.—A company with $25,000 paid-up capital has been formed here. J. J. Shumann is interested.

Albina, Ore.—The following bids for city lighting were recently received: From the Albina Light & Water Co.: each 16 c. p. incandescent lamp, $2.50 per month; each 20 c. p. lamp, $2.75 per month; 2,000 c. p. arc lights, $15 per month. From the Edison General Electric Co., Pacific Northwest District: 2,000 c. p. arc lights $14 per month; 20 c. p. lamps, $2.85 per month; 16 c. p. lamps, $2.70 per month.

Plants are proposed at Earlington, Ky., and Beeville Tex.

New Companies.—Reading, Mass., Electric Light & Power Co.; capital stock, $12,000; L. M. Bancroft, Treasurer.——National Electric Construction Co., Boston, Mass.; capital stock, $2,000,000; Gen. B. F. Butler, President; A. H. Sawtell, General Manager.——Radford Water & Light Co., Radford, Va.; capital stock, $150,000; G. E. Cassel, Secretary.——Suffolk, Va., Light & Water Co.; capital stock, $25,000; C. H. Cansey, Jr., Secretary.——Consolidated Electric Light Co., Birmingham, Ala.; capital stock, $500,000; incorporators, J. F. B. Jackson, R. M. Mulford, R. Jemison.——Momence, Ill., Electric Light Co.; capital stock, $3,000; incorporators: I. C. Picker, L. W. Calkins.—— Temple, Tex., Electric Light Co.——Tulare, Cal., Electric Light & Power Co.; capital stock, $50,000; incorporators: F. W. Eaton, J. C. Turner, G. A. Davis and others. – Seattle, Ore., Gas, Electric Light & Motor Co.; capital stock, $600,000.—— Home Electric Light Co., Seattle, Ore.; capital stock, $500,000.

Storage Battery Plant.—*Detroit, Mich.*—A battery of 264 cells has been placed in the Edison station by the Pumpelly Storage Battery Co., Chicago. This battery enables the station to furnish current throughout the 24 hours while running the dynamos but 10 hours daily.

CONTRACTING.

Paving.—*Brooklyn, N. Y.*—Recent bids for flagging and reflagging sidewalks ranged from 18¾ to 22½ cts. per sq. ft.

Los Angeles, Cal.—A granite block paving contract was recently awarded to C. Scheerer at 26½ cts. per sq. ft.

Dredging.—*New York City.*—Recent bids ranged from 12 to 20 cts. per cu. yd., five proposals being filed.

Asphalt Blocks.—*Washington, D. C.*—John Cox & Co. have received a contract for furnishing the district with blocks at $70.50 per M. P. Malony has a contract for asphalt tiles at $55 per M., and 300,000 blocks at $71 per M.

Street Light.—*Memphis, Tenn.*—The city has contracted with the Equitable Gas Light Co. for gas in public buildings at $0.99 per M. cu. ft., and for street lamps at $12 a year. These are said to be the cheapest rates ever given in a city contract.

Dams.—*New York City.*—The following bids were received by the New Croton Aqueduct Commission for main and auxiliary dams at "Reservoir D":

Bidder.	Main dam.	Auxiliary dam.
M. S. Coleman	$397,263	$83,003
Breuchaud, Pennell & Co.	403,658	84,603
C. Stephens	405,440	113,875
Smith & Brown	407,958	86,050
C. Peterson	422,645	.....
J. J. Ridgway	445,570	96,143

PROPOSALS OPEN.

Grading.—*Boston, Mass.*—About 120,000 cu. yds. of filling. Dep't of Parks. 87 Milk St. Sept. 3.

Brooklyn, N. Y.—Filling. J. J. Adams. Sept. 2.

St. Paul, Minn.—Street grading. R. L. Gorman. Sept. 4.

Paving.—*Brooklyn, N. Y.*—Curbing, guttering and paving with Belgian blocks on several streets; also considerable flagging. J. J. Adams. Sept. 2.

New York City.—Asphalt on concrete, and granite blocks on concrete. T. F. Gilroy. Sept. 8.

Buffalo, N. Y.—Resurfacing with crushed stone. W. McMillan. Sept. 1.

Pittsburg, Pa.—Grading curbing and paving with either block stone. vulcanite, asphalt, irregular block stone or cobble stone. E. M. Bigelow. Sept. 4.

Allegheny, Pa.—Grading, paving and curbing. J. Brown. Sept. 4.

Avondale, O.—Artificial stone sidewalks. W. E. Wynne. Linton Building, Cincinnati, Sept 8.

Sewers.—*Troy, N. Y.*—E. O. Ross, Sept. 2.

Harrison, N. J.—Pipe sewer. J. Wade, Sept. 2.

Pittsburg, Pa.—A 15-in. pipe and 3 to 4¾-ft. brick sewers. E. M. Bigelow, Sept. 4.

Cleveland, O.—Sewers in several streets. C. G. Force, Sept. 4.

Escanaba, Mich.—Engineer's estimate of quantities: 1,290 ft. 20-in. pipe, 410 ft. 12-in. pipe, 3,080 ft. 10-in. pipe, 1,520 ft. 8-in pipe, 19 manholes, 11 lampholes, three 8-in. flushing tanks. J. J. Sourwine, Sept. 2.

St. Louis, Mo.—A number of large contracts are open. Sizes of sewers range from 8½ ft. down to 12-in. G. Burnet, Sept. 5.

Water-Works Plants.—*Allegheny, Pa.*—See advertising columns.

St. Paul, Minn.—Pumping engine of 6,000,000 galls., raised to a height of 158 ft., daily capacity. J. Caulfield, Sept. 22.

Pasco, Wash.—Plant to raise 110 ft. and deliver 20,000 galls. per minute. R. Olney, Sept. 3.

Artesian Well.—*Galveston, Tex.*—Bidders to furnish price for sinking 6, 8, 10 and 12-in. pipes to a depth of 3,000 ft. T. W. Jackson, Sept. 25.

Pipe, Hydrants and Pig Lead.—*Montreal, P. Q.*—About 2,000 tons of cast iron pipe, 160 tons special castings, 75 fire hydrants with 5 nozzles, 75 tons best soft pig lead. B. D. McConnell, Sept. 2.

Valves.—*Pittsburg, Pa.*—Eighty-five brass valves and seats. E. M. Bigelow, Sept. 2.

Pumping Plant.—*Boston Navy Yard.*—Two main pumps of 20,000 galls. per minute capacity and 1 drainage pump of 2,000 galls. per minute capacity. N. H. Farquhar, Washington, D. C., Oct. 8.

Cut Stone.—*Baltimore, Md.*—Dimension stone for pivot pier of Light St. bridge. A. E. Smyrk, Sept. 1.

Iron and Steel Work.—*Norfolk, Va.*—For machine shop extension. N. H. Farquhar, Washington, D. C., Sept. 9.

Materials for Monitor "Puritan."—*Brooklyn Navy Yard.*—About 590,000 lbs. steel plates, 60,000 lbs. rivets, 130,000 lbs. angle bars, 42,500 lbs. bulb, T and Z bars. Address Commandant Brooklyn Navy Yard, Sept. 18.

Piers.—*New York City*—New wooden pier in North River. Dock Dept., Sept. 10.

Philadelphia, Pa.—Coal pier, 600 × 40 ft. H T. Douglas, Chief Eng. B. & O. R. R., Baltimore, Md., Sept. 2.

Lighting Streets.—*Toronto, Ont.*—W. Bell, Sept. 2.

Pile Foundation for Sewers—*New Haven, Conn.*—Piles to be 11 ins. in diameter and creosoted. Approximate estimate of materials per lin. ft. of foundation: 3-5 of a pile, 40 ft. B M., timber; 1.9 lbs. spikes; approximately, 8,200 lin. ft. of work. A. B. Hill, Sept. 3.

MANUFACTURING AND TECHNICAL.

Cars.—The Canadian Pacific Ry. has placed contracts for 100 box cars among the Canadian shops. The amount involved is said to exceed $500,000. The Ohio Falls Car Works are building 32 passenger cars for the Georgia Central R. R. The works are employing more men than ever before in the establishment's history. The Wagner Palace Car Co. is building 10 sleeping cars for the Southwestern Limited trains between New York and St. Louis. The Rio Grande Western has ordered 100 new flat cars, and is now receiving bids for 100 fruit cars.

The Moore Filter Co. will set up two 10-ft. filters in the Chemical Paper Mills at Holyoke, Mass.

Iron Works.—The Cardiff, Tenn., Coal & Iron Co., will erect a blast furnace, 16 × 75 ft., 3 stoves, 19 × 70 ft., 2 blowing engines of 900 HP. each and 5 sets of boilers of 2,200 HP.

The Watts Steel & Iron Co., of London, Eng., have broken ground at Middleborough, Ky., for their large $900,000 open hearth basic steel plant. When the buildings are completed it is said that some three acres will be under roof and that 1,200 men will be employed.

The Nicaragua Canal Co. is reported to have bought the American dredging plant recently in use at Colon. This includes 7 dredges, 15 lighters, several tugboats and the entire machinery lant

The Kingston Dry Dock will have a wider entrance than at first intended, the government having decided to make it 55 ft. in order to accommodate the largest class of lake vessels.

Locomotives.—The Baldwin Works are building twenty 10-wheel freight engines for the Lake Shore & Michigan Southern R. R. These engines weigh 100,000 lbs., 73,000 of which is carried by the drivers. They are said to handle satisfactorily 50 loaded cars on the flat grades of the Lake shore road.

The Brooks Locomotive Works will build six 10-wheel engines for fast passenger service on the Atchison, Topeka & Santa Fe R. R. These engines were designed by Superintendent Player. They will have 19 × 26-in. cylinders and 63-in. drivers with 3½-in. tires. The truck wheels will have steel tires. The boilers will be of the wagon-top crown-bar type, 60 ins. in diameter in front, with 267 flues, 2 ins. in diameter. They will weigh 130,000 lbs., of which 104,000 lbs., will be on the drivers.

The Rio Grande Western has recently ordered four passenger engines of the New York Locomotive Works, and eight freight engines of the Baldwin Works.

Railway Buildings.—The Delaware & Hudson Can a Co. has purchased 13 acres of land at Mechanicville, N. Y., on which to build a roundhouse for the locomotives on its Eastern Susquehanna freight division.

The Cotton Belt Ry. has decided to build roundhouses and shops at Commerce, Tex., the citizens of that place having given the necessary land.

The Old Colony R. R. will build a large depot at Bowenville, R. I.

The Porter Manufacturing Co. is the correct title of the company noticed in these columns last week as the Portland Manufacturing Co.

Tunnels.—The Ingersoll Rock Drill Co. has secured the contract for the machinery to be used in the Busk tunnel on the Colorado Midland Ry. The company will put in four 20 in. × 24 in. straight line compressors, and six 100 HP. boilers. The Ingersoll-Sergeant 3½-in. drill will be used in the work.

New Companies.—The Stanly, Ga., Land & Improvement Co., capital, $1,000,000. The Coleman Rolling Mill Co., South Pittsburg, Tenn., capital. $150,000; President, B. Coleman, St. Louis, Mo. The Continental Powder Co., Ceredo, W. Va., capital $1,000,000; object, the manufacture of smokeless powder. The Paige-Carey Contracting Co., Wheeling, W. Va.; capital. $500,000; incorporators, W. Lathrop, of Cleveland, O,; W. J. Yoder and P. R. Haley, of Wheeling, E. R. Hitchcock, of Armenia, N. Y. Chicago, Ill., Continental Construction Co.; capital, $100,000; incorporators, H. A. Iseland, O. E. Lansing and G. Montague. The U. S. Light & Heat Co., New Orleans, La.; capital, $500,000; incorporators, A. W. Woods, R. L. Heflin and others; object, construction of gas works. Monroe, La., Brick Co.; capital, $50,000; object, manufacture of brick, tiles and sewer pipe. The Chicago, Ill., Elevated Terminal Railroad Co.; capital, $25,000,000; incorporators, J. T. Torrence, J. Donnersberger, T. W. Johnson, J. J. Reynolds and C. Eldred. Wisconsin Bee Line & West Superior Railway Co., Milwaukee; capital. $3,000,000; incorporators, C. D. Smith, F. N. Scott, J. O, Ackerman. Proctor Steel Tower Co., Chicago, Ill.; capital, $2,000,000; incorporators, A. P. Davis, E. M. White and D. R. Proctor; object, construction of towers for scenic purposes. Atlantic & Pacific Railway Construction Co., Chicago. Ill., capital, $500,000; incorporators, J. C. Reynolds, M. J. Miller and G. F. Watson. Georgia Rolling Stock Co., Macon, Ga.; capital, $250,000; incorporators, H. J. Lamar, J. S. Schofield, J. W. Cabaniss, T. W. Troy and J. S. Baxter; object, car building.

Metal Market Prices.—*Rails*—New York: $30.50 to $31 for old iron rails, $24 to $24.50. Chicago: $33.50; old rails, $26.50 for iron, $19 to $21, for steel. Pittsburg: $31.50 to $32.50; old rails, $27.50 to $28 for iron; $21.50 to $22.50 for steel.

Foundry Pig-iron.—Chicago : $15.50 to $17.50. Pittsburg: $15.75 to $17.50. New York: $16 to $18.

Track Materials.—New York: steel angle bars, 1.85 to 1.9 cts.; spikes, $2 to $2.10; track bolts, 2.9 to 3.10 cts. with square, and 3.10 to 3.15 cts. with hexagon nuts. Pittsburg: splice bars, 1.95 to 2 cts. for iron, 2 to 2.1 cts. for steel; spikes, 2.15 cts.; track bolts, 2.85 with square, and 3 cts. with hexagon nuts. Chicago: splice bars, 2.25 cts. for steel, and 2 to 2.1 cts. for iron; spikes, 2.2 cts; track bolts 3.05 to 3.15 cts. with hexagon nuts.

Pipe.—Cast-iron, $27 to $30 per ton. Wrought iron, discounts as follows: 47½ and 40 per cent. on black and galvanized butt-welded; 60 and 47½ on black and galvanized lap-welded. Casing, 50 per cent.

Lead.—New York, 4.35 to 4.65 cts.; Chicago, 4.45 to 4.52½ cts.

Structural Material.—Pittsburg : angles, 2.2 to 2.25 cts.; tees, 2.8 to 2.85 cts.; beams and channels, 3.1 cts.; sheared steel bridge plates, 2.7 cts.; universal mill plates, 2.55 cts.; refined bars, 1.9 to 2 cts.; steel plates, 4.25 to 4.75 cts. for fire box; 3.2 to 3.25 cts. for flange; 3.05 cts. for shell, 2.7 to 2.75 cts. for tank. New York: beams, 3.10 cts.; plates, 2.15 to 2.20 cts.; angles, 2.25 cts.; tees, 2.5 to 2.6 cts.; channels, 3.1 cts. Chicago: angle, 2.35 to 2.4 cts.; tees, 2.8 to 2.9 cts.; beams, 3.2 cts.; universal plates, 2.45 to 2.56 cts.

Coldwater, Mich., Water-Works.

Notice to Contractors.

SEALED PROPOSALS will be received by the Water-Works Committee of the City of Coldwater, Mich., at their office in said city until 10 o'clock A. M. of Tuesday, the 16th day of September, 1890, for furnishing all materials and constructing water-works in and for said city.

The pipe distribution will consist approximately as follows: 240 lin. ft., 16 tons 16-in.; 1,250 lin. ft., 52 tons 12-in.; 5,800 lin. ft., 188 tons 10-in.; 18,660 lin. ft., 467 tons 8-in.; 29,180 lin. ft., 461 tons 6-in., and 12,730 lin. ft., 146 tons of 4-in. pipe; total, 1,390 tons of pipe and 30 tons of special castings. Also, thirty-one 4-in. valves, thirty-eight 6-in., fourteen 8-in., two 10-in., and one 12-in. valve.

Also, 86 valve boxes and covers; also, 10 fire hydrants.

The pumping station will consist of one brick building, sub-divided into an engine room, a boiler room, a coal room and working room; the engine and boiler rooms to be large enough to accommodate an electric light plant, all as per detail drawings.

The supply well will be approximately 30 ft diameter and 30 ft. deep, walled with brick and covered with ornamental well house. Bids will also be received for six or more 6-in. pipe wells, as per general specifications; also, for such a system of wells as bidders may elect to submit specifications and proposals for.

The pumping machinery, as now contemplated, will consist of two compound duplex condensing pumping engines, each with safe and easy capacity to pump one million five hundred thousand (1,500,000) gallons of water per 24 hours; arranged to work most economically under ordinary current pressure of 50 to 60 lbs., with additional strength of parts sufficient to work safely against fire pressure of 150 lbs. per sq. in. Bids will also be received for such cheaper type of engines as may be described in specifications.

The boilers will consist of two return tubular steel boilers, each approximately 60 ins diam. and 16 ft. long. Bids will also be received for such other type of boilers as bidders may elect to submit, or as may be described in general specifications.

Bids for pumping machinery will be understood to include foundations and settings complete, and bids for boilers will be understood to include all foundations, settings and fixtures complete, unless otherwise expressly stipulated.

Specifications, forms of proposal and forms of contract will be furnished from and after Sept. 6, and the necessary detailed drawings will be ready for the examination of bidders from and after Sept. 10, 1890.

Bids will be received for the entire work in the aggregate, or in detail, at the option of bidders. The right to reject any or all bids is hereby reserved.

E. R. CLARKE, Mayor.
E. J. ALLEN, Clerk.
F. E. MORGAN, Secretary of Water Committee.
J. D. COOK, Toledo, O., Consulting Engineer.

COLDWATER, Mich., Aug. 26, 1890.

35-2t

THE INDEPENDENT.

Government Ownership of Railways and other phases of the Railroad Question discussed this week by Hon. CASSIUS M. CLAY, EDWARD EVERETT HALE, Ex-Gov. WILLIAM LARRABEE, Prof. RICHARD T. ELY, W. D. DABNEY, JOHN P. MEANY, Editor of "Poor's Manual of Railroads," and by seventy Presidents, General Managers and Superintendents of Railroads in the United States.

Price 10 cents. One year, $3.00. Two years, $5.00.

35-1t **251 BROADWAY, N. Y.**

Sealed Proposals.

CLERK'S OFFICE,
TOWNSHIP OF EAST ORANGE, N. J.

Sealed proposals for furnishing about three hundred granite street monuments will be received by the Township Committee of the Township of East Orange, N. J., on or before Sept. 8, 1890, at eight o'clock P. M. Plans and specifications may be procured of Wm. H. V. Reimer, Township Engineer, 249 Main street, Orange, N. J. The committee reserves the right to accept or reject any or all bids.

Proposals must be directed to Alfred F. Munn, Township Clerk.

ALFRED F. MUNN,
35-2t Township Clerk.

S. E. NOBLE, Prest. JNO. E. WARE, Secy. and Treas. R. F. CARTER, Supt.

The Anniston Pipe Works,

MANUFACTURERS OF

CAST IRON WATER AND GAS PIPE,

ANNISTON, - - - - ALA.

Especially adapted for the Elevation of Clear, Gritty, Thick, or Acidulous Liquids, Quickly, Cheaply and Efficiently

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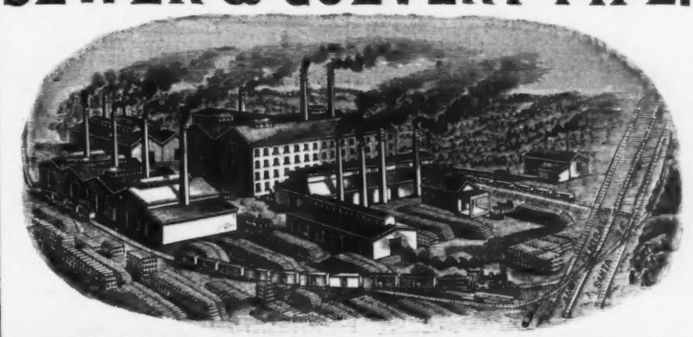


MONMOUTH MINING & MFG. CO., MONMOUTH, ILL.

PROPOSALS FOR LOCK CONSTRUCTION. Engineer's Office, U. S. Army, Nashville, Tennessee, August 18, 1890. Sealed proposals, in triplicate, will be received at this office until 3 P. M. Tuesday, September 23, 1890, for part construction and completion of Lock No. 1, Cumberland River, near Nashville, Tennessee. Bidders are invited to be present at opening of the bids. The United States reserves the right to reject any and all proposals. The attention of bidders is invited to the acts of Congress, approved February 26, 1885, and February 23, 1887, Vol. 23, page 332, and Vol. 24, page 414, Statutes at Large. Specifications and blank forms for proposals will be furnished on application at this office. J. W. BARLOW, Lieut. Col. of Engineers. 35-4t

PROPOSALS for furnishing and placing stone on breakwater at Bar Harbor, Maine. United States Engineer's Office, Portland, Maine, Aug. 25, 1890. Sealed proposals in triplicate for furnishing and placing stone on the breakwater at Bar Harbor, Maine, will be received at this office, No. 537 Congress St., until 3 P. M., of Thursday, Sept. 25, 1890, and then opened. Attention is invited to Acts of Congress, approved Feb. 26, 1885, and Feb. 23, 1887, Vol. 23, page 414, Statutes at Large. All necessary information furnished on application to JARED A. SMITH, Lieut. Col. Corps of Engineers, U. S. Army. 35 1t—37 2t

Freehold, N. J., Water-Works.

SEALED PROPOSALS will be received by the undersigned, Water Commissioners of the Town of Freehold, New Jersey, until 12 o'clock noon, on Saturday, Sept. 6, 1890, for the furnishing of cast-iron water pipes, with the necessary special castings, etc.

Also for furnishing the necessary valves and fire hydrants.

Also for furnishing the material and labor for the excavating of trenches and laying of the pipes in the Town of Freehold.

Also for furnishing and erecting of a standpipe.

Further information will be furnished by A. Harvey Tyson, member American Society Civil Engineers, at his office, 526 Court St., Reading, Pa., where plans can be seen and blank forms of proposal and specifications procured.

The right is reserved to reject any or all bids.

A. C. HARTSHORNE, President,
JOHN ENRIGHT, Secretary,
JOSEPH BRAKELY,
35-1t Water Commissioners.

Artesian Well Contractors.

Sealed bids will be received up to 6 P. M. **Sept. 20, 1890,** for an artesian well to furnish not less than 200,000 gallons of water daily. Bids to be of two kinds:

1st. Total cost; no water, no pay.

2d. Price per foot of lineal depth; size of pipe to be specified in both cases.

A bond of $500 to begin work within 30 days from acceptance of bid and to complete work in reasonable time must accompany bid.

Right reserved to reject any and all bids.

M. G. RANNEY, City Secy.
YOAKUM, Tex., Aug. 13, 1890. 34-2t

To Sewer Contractors.

Proposals will be received until Monday, Sept. 8, 5 P. M., by James J. Bergen, President of Board of Commissioners of Somerville, N. J., for constructing approximately four miles of sewers at Somerville, N. J., as follows: 800 ft. 24-in., 1,300 ft. 20-in., 3,730 ft. 15-in., 920 ft. 12-in., 720 ft. 10-in., 1,380 ft. 9-in., 11,240 ft. 8-in., with manholes, basins, inlets and appurtenances.

A certified check for $500, drawn to the order of L. R. Vredenburgh, Treasurer, must accompany each bid as an evidence of good faith.

The right is reserved to reject any and all bids. Plans may be seen at the office of Jas. Dougherty, Somerville, N. J, or at the office of the engineer in charge, Carrol Ph. Bassett, 784 Broad St., Newark, N. J.

(Signed) JAS. J. BERGEN,
Pres. Board of Commissioners of
35-2t Somerville, N. J.

Artesian Well.

Sealed proposals will be received by the undersigned at the City Hall, Galveston, Texas, up to 12 o'clock, noon, of Thursday, Sept. 25, A. D., 1890, for the boring of an artesian well in the City of Galveston, to a depth of 3,000 ft., unless satisfactory water is procured at a lesser depth. Bidders to give price per foot for finishing with 6-in., 8-in., 10-in. and 12-in. pipe respectively. The right to reject any or all bids is reserved. THOS. W. JACKSON,
35-5t Chairman of Special Committee.

Notice to Contractors for Water Works Plant.

OFFICE OF THE COMPTROLLER,
CITY OF ALLEGHENY, Aug. 7, 1890.

Sealed proposals will be received at this office until 12 o'clock noon Wednesday, October 1, 1890, for doing the following work viz.:

PUMPING ENGINES.

For the construction and erection of two pumping engines of a capacity of 8,000,000 gallons each, to be of the type known as the vertical direct-acting three-cylinder compound condensing engines, with a combined capacity of pumping 16,000,000 gallons every 24 hours against a head of 300 feet, with a piston speed not exceeding 120 feet per minute.

RESERVOIRS.

For the construction of two basins having 460 by 660 feet surface at foot of embankments, said embankments to be 30 feet above bottom of basins. The reservoirs to have one inlet and one outlet gate chamber.

STOP GATES.

For furnishing six sixty-inch stop gates, to be doubled seated, with parallel-faced valves of easy adjustment, to be operated with two screw stems parallel to each other, and connected by suitable gear.

BOILERS.

For a 1,500 horse-power boiler plant; boilers to be set up in batteries not exceeding 300 horse power, with a given guarantee on evaporative power of boiler per pound of coal consumed. Boilers will be placed in position and set up by the contractor on foundations furnished by the city.

FILTERING PLANT.

Proposals will be received for the construction and erection of a filtering plant to be used in connection with new water service, to be erected at a point nine miles up the Allegheny River Bidders to furnish their own plans and specifications, erect their plants, and operate the same for a period of not less than six months on trial, and if satisfactory to the Committee on Water and Superintendent of Water-Works, the contract price to be paid; if not satisfactory, they to remove the plant without cost to the city.

CONDUIT AND FORCE MAINS.

For the construction and laying of a 60-inch steel or iron conduit from Nine-Mile island to the city, about 8.74 miles, to be in sections of 24 ft. in length from center to center of joints. Manholes to be provided for every 40 sections of water main. Elbows for vertical and horizontal inclinations to be provided for, with angles as shown on plan and profile. Force main to be fifty (50) inches in diameter, and constructed as per plans and specifications.

Plans and specifications for buildings, reservoirs, conduit force mains and delivery pipe will be furnished by the city.

Bidders will furnish their own plans and specifications in full detail for engines and boilers, and their connections, with necessary plans for foundations for same.

Proposals will be received for the construction of the whole work, or separately, as bidders may elect.

Plans and specifications may be seen and all information in regard to the above work can be obtained at the office of the Superintendent of Water-Works, and all correspondence in relation to the same should be addressed to Edward Armstrong, Superintendent, City Hall, Allegheny, Pa.

A bond must accompany each proposal to the full amount of the bid, with sufficient sureties for the faithful performance of the contract.

The right is reserved by the Committee on Water to accept or reject bids for the whole or any part of the above work.

JAMES BROWN,
33-6t Comptroller.

Proposals for Key West Improvements.

OFFICE OF CITY CLERK,
KEY WEST, Fla., June 2, 1890.

Sealed proposals will be received by the City Clerk of Key West, Fla., until 1st of October, 1890, for furnishing the necessary material and putting in an underground system of sewerage; also for grading and paving the streets of said city and furnishing the material for same; also for furnishing and laying of water mains.

1st. All bids must be made upon the printed forms to be obtained from the City Clerk and inclosed in a sealed envelope, directed to the Board of City Commissioners and marked on the outside of envelope, "Proposals for Key West Improvements."

2d. Each bid must be accompanied by a cash deposit or certified check of five hundred dollars, to be left in the hands of the City Clerk subject to the conditions specified, as a guarantee of the good faith of the bidder.

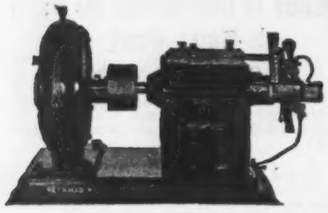
3d. The city reserves the right to reject any and all bids.

4th. Bidders are requested to be present at the opening of the bids.

5th. Bidders are expected to bid separately on sewer system and material, on grading and paving of streets and on furnishing and laying water mains.

6th. Plans and specifications can be seen at the office of the City Clerk and at the office of Johnson & Flad, Consulting Engineers, Laclede Building, St. Louis, Mo.

WM. L. DELANEY,
25-3t City Clerk.



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Lighting Plants for Water-Works Pumping Stations a Specialty.

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The laying of 1,400 cu. yds. Heavy Granite and Limestone Masonry in Mississippi River at this place. Will furnish material and plant to right man.

McCORMICK & O'MEARA,
33- 904 Olive St., St. Louis, Mo.

CONTRACTORS' PLANT

For Sale Cheap.

A quantity of 6, 10 and 12-in. CAST-IRON PIPE, R. D Wood & Co. make, tested to Government standard and weights; has been used only to convey compressed air and is good as new. Also a quantity of WROUGHT-IRON PIPE 1, 2, 3 and 4 in., in good order, besides COMPRESSOR, BOILER, ENGINE, DERRICKS, 3 KNOWLES STEAM PUMPS STEAM BOILER, ONE STEAM SHOVEL, and a large amount of CONTRACTORS' PLANT. For particulars, price, etc., inquire of

BECKWITH, QUACKENBUSH, & CO.,
2,925 M. St., N. W., Georgetown, D. C.

FOR SALE.

Established business of Civil Engineering, and Surveying, located on Puget Sound, Wash. Complete notes, maps, instruments and office fixtures. Fine opportunity for young civil engineer. Address ENGINEER, care Engineering News. 33-4t

WANTED.

To know the present address of Mr. Francis F. Hopp, a civil engineer, and within a year a resident of Birmingham, Ala.

BUFF & BERGER,
28-8t Boston, Mass.

Notice to Contractors.

Bids will be opened on the 28th of August for the letting of about three millions of brick work at this point. For specifications and plans apply at the office of The Manufacturing Investment Co., Madison, Maine. 34-2t

Franklinville, N. Y., Water-Works.

NOTICE TO CONTRACTORS.

Sealed proposals will be received by the Board of Water Commissioners of the village of Franklinville, New York, until six o'clock P. M., of the fourth day of September, 1890, at the office of the secretary of the board, for the material and labor to construct water-works for said village.

Proposals must be made upon blank forms furnished by the commissioners and be accompanied with cash or a certified check or draft for one thousand dollars payable to the treasurer of the Board of the Water Commissioners as a guarantee for the execution of a contract if the proposals shall be accepted. The right is reserved to reject any and all proposals.

Dated Franklinville, N. Y., Aug. 11, 1890.

A. O. HOLMES,
D. W. DEAN,
ALFRED SPRING,
SAMUEL A. SPRING.

ALFRED SPRING, Secretary. 33-3t

Masonry and Excavation.

NOTICE TO CONTRACTORS.

The city of Austin, Tex., will receive bids until 12 o'clock noon of Oct. 15, 1890, for construction of a DAM across the Colorado River and excavation of a HYDRAULIC CANAL near Austin.

Said work involves some

17,000 cu. yds.,	dimension stone	masonry;
70,000 "	rubble "	"
75,000 "	earth excavation;	
55,000 "	rock "	

Full information, with specifications and forms for proposals, contract and bonds, may be obtained on application to John McDonald, Mayor, or Jos. P. Frizell, Engineer, Austin, Tex.

JOHN McDONALD, Mayor.
August 6, 1890. 33-4t.

LIFTING APPARATUSES.

A large *Machine Manufactory* in *Germany* seeks an *Engineer* who must be *thoroughly experienced in every respect* with the manufacture of Lifting Apparatuses, and particularly be acquainted with the latest and best constructions of *Hydraulic Lifts* and *Cranes*. Only gentlemen of the *highest ability* will please apply to R. W., 770, care of *Haasenstein & Vogler, A. G., Berlin S. W.* 34-2t

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PROPOSALS FOR GRANITE PAVING Blocks, to be used on the Streets and Avenues in the City of Washington, D. C.

OFFICE OF THE COMMISSIONERS,
WASHINGTON, D. C., Aug. 11, 1890.

Sealed proposals will be received at this office until 12 o'clock M. on Thursday, Sept. 4, 1890, for furnishing granite paving blocks, to be used on various streets and avenues in the city of Washington.

Blank forms of proposals and specifications can be obtained at this office on application therefor, together with all necessary information, and bids on these forms only will be considered.

The right is reserved to reject any and all bids or parts of bids.

J. W. DOUGLASS,
L. G. HINE,
H. M. ROBERT, } Commissioners, D. C.

33-3t

PROPOSALS FOR GRANITE CURBING, to be used on the Streets and Avenues in the City of Washington, D. C.

OFFICE OF THE COMMISSIONERS,
WASHINGTON, D. C., Aug. 11, 1890.

Sealed proposals will be received at this office until 12 o'clock M. on Thursday, Sept. 4, 1890, for furnishing granite curb, to be used on various streets and avenues in the city of Washington.

Blank forms of proposals and specifications can be obtained at this office on application therefor, together with all necessary information, and bids on these forms only will be considered.

The right is reserved to reject any and all bids or parts of bids.

J. W. DOUGLASS,
L. G. HINE,
H. M. ROBERT, } Commissioners, D. C.

33-3t

IMPROVEMENT OF PHILADELPHIA HARBOR. U. S. Engineer Office, 1428 Arch street, Philadelphia, Pa., Aug. 16, 1890. Sealed proposals, in duplicate, will be received at this office until 11 A. M. Tuesday, Sept. 16, 1890, and then opened, for dredging in Philadelphia Harbor, Pa., for removal of Smith's and Windmill Islands. The attention of bidders is invited to the Acts of Congress approved Feb. 26, 1885, and Feb. 23, 1887, Vol. 23, page 332, and Vol. 24, page 414, Statutes at large. For all information apply to C. W. RAYMOND, Major of Engineers, U. S. Army. 34-4t

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If you want to make up a Survey Party!

If you want an Engineer on Construction!

If you want to fill a vacancy in maintenance of Way Department!

If you want an Engineer for Special Service!

If you want a Draughtsman!

If you want a Contractor!

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IN

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WANTED.—A competent draughtsman to make shop and picture plans, highway bridge work A permanent position for first class man. Apply by letter only, giving references. Address DEAN & WESTBROOK, N o. 32 Liberty St. 32-4t

WANTED.—Graduate Fellowship, Vanderbilt University—A Graduate Fellowship in Engineering for the next session of the Vanderbilt University will be awarded Sept. 1, 1890. The duties will be the prosecution of advanced studies in engineering and a certain amount of assistance in the engineering laboratories and field-work. Salary, three hundred dollars ($300) and free tuition and quarters. Applicants will be required to submit a statement of and testimonials to their qualifications before the date named. For further information address

O. H. LANDRETH, Dean,
33-3t Nashville, Tenn.

WANTED.—Thomas M. Jacks, City Engineer of Helena, Ark., wants an engineer of experience to assist in the resurvey of the streets, squares, etc., of the city of Helena, Ark., embracing about 800 acres of land inhabited by 8,000 people. Applicants please address THOMAS M. JACKS, City Engineer, Box 17, Helena, Ark. 33-4t.

WANTED.—An experienced and competent superintendent for bridge shop engaged in first-class steel and iron riveted work. Address, giving experience and references, HILTON BRIDGE CO., Albany, N. Y. 34-2t

WANTED—A trackmaster of experience. A liberal salary will be paid. Apply by letter, giving references, to TRACKMASTER, care of Engineering News. 34-4t

WANTED.—A sober, good-tempered, experienced engineer to take charge of erection and operation of rock drills, air compressors, Corliss engines and general machinery in a mine in a foreign country; must be experienced with Ingersoll-Sergeant machinery; contract for one year, with privilege of renewal; pay $5 per day and expenses, including board and lodging; only experienced men, highly recommended, will be considered. Address WILLIAM L. SAUNDERS, 10 Park Place, New York. 34-4t

WANTED.—"There is a vacancy in my office for a competent assistant, which to the right kind of a man will be of service to him in qualifying for the practical work of an engineer. He must be a neat, rapid and correct draughtsman, accurate in his arithmetical work, of good temper and habits, and willing to study his employer's interests and make himself useful. I prefer a young man from 23 to 25 years old, or one younger will do if he has had experience.

"Do you know of some one who would like to come into my line of work and be educated in the practical work of water-works and sewerage construction? If so give me his address and I will correspond with him."

The above is from one of the leading hydraulic engineers of this country, with office in one of the principal cities of Ohio. Letters may be addressed for *two weeks only* to HYDRAULIC ENGINEER, care Engineering News.

WANTED.—Ten (10) experienced rock foremen to work on extension Norfolk & Western Railway, in Wayne County, W. Va. Good wages to experienced foremen. Apply at Louisa, Ky., on the Ohio & Big Sandy Railway, eight miles from work. GEO. S. GOOD, Contractor. 35-2t

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WANTED.—Capitalists to invest in the manufacture, and to form companies to manufacture, and to procure franchises to build water-works of the best water pipe and patented joint now in operation. To those wishing to become interested a strict examination of the pipe and joint is solicited. For particulars enquire of CHAS. T. LEONARD, Norwalk, Conn. 32-5t

WANTED.—Engineer's Transit, with level attachment, reading 20 or 30 seconds. Address, with particulars and price, CITY ENGINEER, Springfield, Mass. 33-2t

$20 REWARD for return of Transit stolen from buggy at my office, 91 Washington St., Chicago, November last. Made by Benj. Pike's Sons. Has full circle, vertical arc, with F. C. R. stamped in compass box. F. C. ROSSITER. 33-3t

WANTED.—A partner in a contract that promises good returns. A man who can command $50,000 can find good security and good profits. He should be a capable accountant and able to attend to the office work. Address VAN AUKEN, Engineering News. 34-3t

WANTED.—Second-hand air compressor; must be in good order. Air cylinder about 12 × 18 inches. MICHIGAN STOVE CO., Detroit, Mich. 35-1t

Earth Work Slips and Subsidences upon Public Works, their causes, prevention and reparation. Especially written to assist those engaged in the construction or maintenance of Railways, Ditches, Canals, Roads, Water-Works, River Banks, Reclamations, Embankments, etc., etc. By John Newman, 12mo, cloth. London, 1890. $3.00.

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SITUATIONS WANTED.

WANTED.—A civil engineer and draughtsman of 15 years' experience on location and construction of railroads and water-works, wishes a position. Services available about Sept. 1. Tunnelling and masonry specialties. Topography, etc. "X.," care Engineering News. 35-4t

WANTED.—A position in charge of surveys or construction; water-works or sewerage preferred; or a position likely to be permanent with a city engineer or engineering firm. Salary not less than $100 per month. Can furnish instruments and am good draughtsman. Good experience and first-class references. At liberty about Sept. 15. Address E. N. P., care ENGINEERING NEWS. 32-4t

WANTED.—Engineer having experience—railway location and construction, water-works, etc., —desires to find employment with parties in New York City or vicinity, where there is chance of permanent position. Reference. F. D., ENGINEERING NEWS. 32-4t

WANTED.—A civil engineer with ten years experience principally on city work would like to secure an engagement lasting from four to six months beginning about October 1. Have been five years on New York City work; been assistant engineer of an Eastern city of 40,000; city engineer of another place for two years, besides having a large practice on other general work. Can make surveys, plans and take charge of construction of works of sewerage and anything under the head of city engineering, and am an expert on the most accurate city surveying. Am also an A1 map draughtsman and can send sample of work. Some railroad experience. Can furnish my own instruments. At present in Wisconsin. Address CITY ENGINEER, care of Engineering News. 33-4t

WANTED.—Position as instrument man, resident engineer on railroad location and construction, or office work, by an engineer who has engineering education, four years' experience, ability, steady habits, and first-class recommendations. Address P. O. Box 315, Monroeton, Pa. 35-1t

WANTED.—A position with railroad engineering corps as either transit or levelman; experience in preliminary or locating survey. References, Address E. L. H., care Engineering News. 35-2t

WANTED.—Architect at present engaged in private practice wishes position with railroad company. Well up in designing, construction and business management. Has had experience in railroad work. Address ARCHITECT, care Engineering News. 35-2t

WANTED.—Situation after Nov. 15, 1890, as leveler or transitman on railroad or city work. Have had six years' experience in land and lot surveying, bridge and gravel road building, and public (country) drainage. Reason for change, expiration of term of office. Address COUNTY SURVEYOR, Box 66, Rushville, Ind. 35-2t

WANTED.—Two experienced draughtsmen can be secured by Sept. 15. Address Railroad and Architectural Draughtsman, care Engineering News. 35-2t

WANTED.—A young engineer, who can give good references, desires a place as transit observer or leveler with a corps on preliminary survey or location. Address "PERRY," care Engineering News. 35-4t

WANTED.—A young mining and civil engineer, with nearly five years of good, sound, practical experience, at present engaged, desires to make a change to the South or West, extreme Northwest preferred. Address TRANSITMAN, care of Engineering News, New York. 34-2t

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